



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.06.2012 Bulletin 2012/26

(51) Int Cl.:
G07C 5/00 (2006.01) G07C 5/08 (2006.01)

(21) Application number: **11195153.9**

(22) Date of filing: **22.12.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(72) Inventors:
• **De Tommasi, Claudio**
I-10078 Venaria Reale (Torino) (IT)
• **Bergamini, Alessandro**
I-10078 Venaria Reale (Torino) (IT)

(30) Priority: **24.12.2010 IT TO20101061**

(74) Representative: **Deambrogi, Edgardo et al**
Corso Emilia 8
10152 Torino (IT)

(71) Applicant: **Magneti Marelli S.p.A.**
20011 Corbetta (MI) (IT)

(54) **Method for detecting harsh driving operations of a vehicle and system for monitoring the driving conditions of a vehicle**

(57) The invention describes a method for detecting harsh driving operations of a vehicle (V), based on acquiring (110) data indicative of at least an entity representing the dynamic behaviour of the vehicle (V) at pre-determined sampling times, and on comparing (1401, 1402, 1403) the data acquired with a respective pre-determined threshold value, adapted to distinguish an anomalous driving event. When the data acquired ex-

ceed the respective threshold value a counter of anomalous driving events is incremented (1411, 1412, 1413), the counter being decremented (1421, 1422, 1423) from a non-zero value when the acquired data do not exceed the threshold value. A harsh operation is detected (150) when the counter of anomalous driving events exceeds (1431, 1441; 1432, 1442; 1433, 1443) a predetermined warning threshold.

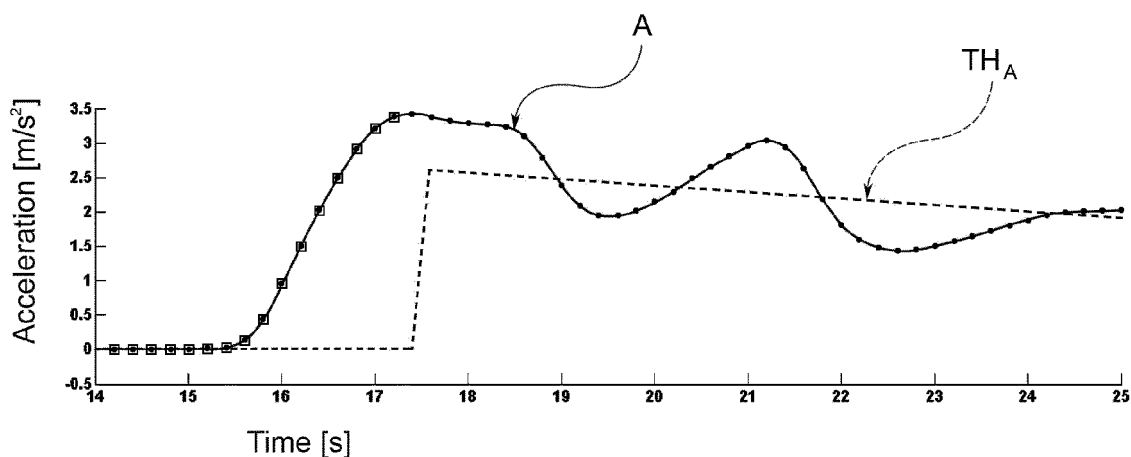


FIG. 5a

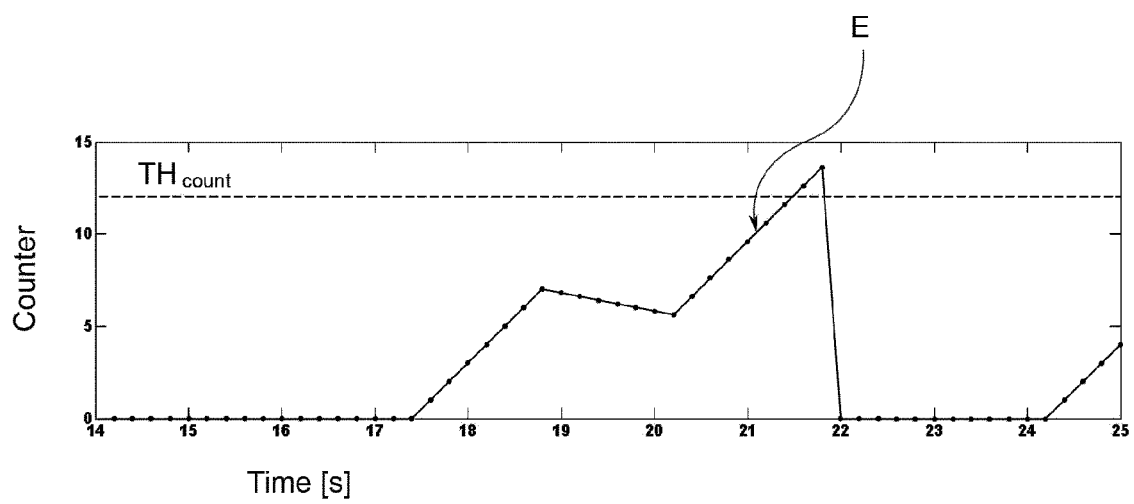


FIG. 5b

Description

[0001] The present invention in general concerns systems for monitoring the driving conditions of a vehicle and more specifically a method for detecting harsh driving operations according to the preamble of claim 1, and a system for monitoring the driving conditions of a vehicle.

[0002] There is constantly increasing use of vehicles that have position, attitude or acceleration sensors installed on-board, in order to provide accurate indications on the position and orientation of the vehicle in space and on its movement dynamics. Such devices not only contribute to the operativity of the on-board driving assistance systems, but are essential for the functionality of other auxiliary systems including, to quote one example, systems for monitoring and recording the dynamics of use of the vehicle, such as systems used in anti-theft devices, in devices for controlling vehicles belonging to a fleet or in devices, known by the name black box, for detecting infractions or the dynamics of road accidents, for example to help to law enforcement or insurance companies.

[0003] Typically, a system for monitoring and recording the dynamics of use of a vehicle is arranged to detect the driving conditions of the vehicle (travelling speed, overall travelling time, engine operating regime) in view of their transmission to a remote analysis station. The data can be periodically transferred to the analysis station through an on-board communication system or simply recorded in an impenetrable storage medium available on-board the vehicle, from where they can be taken at a later time, for example when the vehicle is subjected to a programmed periodic maintenance intervention.

[0004] In both of the cases described above the monitoring system is arranged to indistinctly and continuously record all driving events of the vehicle, for the period in which it is activated. This involves the need to transfer large amounts of data frequently, or to foresee data storage supports of sufficient capacity to conserve the recorded data relating to a long time period.

[0005] The present invention has been set the purpose of providing a satisfactory solution to the problems outlined earlier, by making a method and a system for detecting harsh driving operations that avoids the drawbacks of the prior art, allowing a system for monitoring and recording the dynamics of use of a vehicle to consider just events detected as irregular operations like events able to be considered by an analysis station for further processing.

[0006] A further purpose of the invention is to provide a method for detecting harsh driving operations with low probability of error due to false detections.

[0007] According to the present invention such a purpose is accomplished thanks to a method for detecting harsh driving operations, having the characteristics outlined in claim 1.

[0008] A further object of the invention is a system for monitoring the driving conditions of a vehicle, having the characteristics outlined in claim 10.

[0009] Particular embodiments form the subject of the dependent claims, the content of which should be taken to be an integral part of the present description.

[0010] In brief, the present invention is based on the principle of verifying the occurrence of anomalous driving conditions, such as in particular harsh driving operations linked to sudden variations in acceleration of the vehicle, through systems for detecting the vehicle dynamics available on-board, and detecting possible warning conditions in the case of an aggregation of anomalous driving events over time, also in the presence of discontinuity for short periods of time.

[0011] Advantageously, the anomalous driving conditions are detected through threshold tests on the intensity of the measured detection parameter and on the time period for which the detection parameter exceeds the warning threshold.

[0012] In particular, in order to avoid a multiple detection of a single event that is continuous over time, and to better describe the evolution of the event over time, the detection (and consequent recording) of the relevant driving condition does not end with the detection of the event, but lasts until the end of the event itself.

[0013] In this way, the system for detecting driving conditions according to the invention makes it possible to store and/or transmit just the relevant data able to identify particular predetermined anomalous driving conditions, avoiding storing and/or transmitting large volumes of data.

[0014] Further characteristics and advantages of the invention will be outlined in greater detail in the following detailed description of an embodiment thereof, given as a non-limiting example, with reference to the attached drawings, in which:

figure 1 is a schematic representation of a vehicle equipped with a unit for monitoring and recording the driving conditions according to the invention;

figure 2 is a block diagram of a system for detecting harsh driving operations according to the invention;

figures 3a and 3b are flow diagrams, overall and detailed respectively, of a method for detecting harsh driving operations, according to the invention;

figure 4 shows a diagram indicating the variation of the harsh acceleration threshold as the travelling speed of the vehicle varies;

figures 5a and 5b are diagrams indicating the threshold comparison and the counting of events in the case of a harsh acceleration;

figures 6a and 6b are diagrams indicating the threshold comparison and the counting of events in the case of a harsh turn operation; and
 figures 7a and 7b are diagrams indicating the threshold comparison and the counting of events in the case of a turn operation not recognised as a harsh operation.

[0015] In figure 1 V generally indicates a vehicle, equipped with a telematic unit T provided to monitor and record the conditions of use of the vehicle, in particular the dynamic driving conditions. The telematic unit is provided with means for detecting the dynamic conditions of the vehicle, in particular adapted to measure or calculate the linear and centripetal accelerations to which the vehicle is subjected during the different driving conditions, in particular during harsh braking, start-up or turn operations.

[0016] Preferably, the means for detecting the dynamic conditions of the vehicle comprise receiving means R of a positioning system, for example a GPS satellite positioning system. Other sources of data representing the dynamic conditions of the vehicle can be considered as an alternative to a GPS receiver, for example on-board inertial sensor devices like accelerometers or triaxial gyroscopes, or differential odometric sensors integrated on-board the vehicle for autonomously measuring the distances travelled through the rotation measurements of the wheels of the vehicle.

[0017] Again in figure 1, X, Y, Z indicate the main axes of the vehicle, commonly identified as longitudinal, transversal and vertical axis, and with respect to which the movements of the vehicle are defined, for example the speeds, the accelerations, and the angles of inclination thereof in all driving conditions.

[0018] The telematic unit T can be installed on-board the vehicle at the moment of its production and interfaced with a communication line integrated on-board, for example the CAN bus, for transferring the acquired data to other processing units of the vehicle. Alternatively, the unit is mounted on-board the vehicle after its production and it can be connected to other processing units through a dedicated communication line or it can operate autonomously, for example establishing a wireless communication towards a remote server.

[0019] As indicated in detail in the block diagram of figure 2, in addition to the GPS receiver R the telematic unit comprises an electronic processing unit E, in turn coupled with an interfacing communication module, generally indicated with C, for example a GSM, GPRS or 3G modem suitable for receiving interrogation signals from a remote control station (not depicted) and for transmitting to the aforementioned station the recorded data representing the driving conditions that the vehicle is (was) subjected to. The processing unit E also has memory modules M1 and M2 associated with it, typically a random access memory module M1 for storing temporary data and for the computing process and a flash memory module M2 for permanently storing data.

[0020] The processing unit E is a calculation unit provided to acquire data about the dynamic behaviour of the vehicle, to compare them with the predetermined threshold values and to permanently record, in an associated memory module, the data representing an anomalous dynamic behaviour of the vehicle.

[0021] The processing unit E is arranged for detecting the data identifying an anomalous driving condition from the data indicative of the dynamic behaviour of the vehicle over time, by application of a method for detecting harsh driving operations that will be described in detail hereafter with reference to the flow diagram of figure 3a and 3b.

[0022] For example, but not exclusively, the telematic unit T can be mounted on-board the vehicle and intended to make a system for monitoring and recording the movements of the vehicle, for example an accessory system to an anti-theft device or a system for detecting the movements of a vehicle belonging to a fleet, or even a system for detecting infractions or the dynamics of road accidents.

[0023] After a preliminary initialization step 100, the processing unit E in step 110 acquires data representing the dynamics of the vehicle from the GPS receiver R. Such data, typically the evolution of the position data of the vehicle over time, make it possible to determine corresponding reference data of the accelerations of the vehicle along the main axes X, Y, Z.

[0024] The positioning data are filtered in step 120 to eliminate the unreliable data. If the data are not reliable, the system switches in state 130, where the method for detecting the driving condition is reset with another acquisition of dynamic data in step 110.

[0025] Hereafter we shall briefly mention the filtering techniques of the GPS positioning data that are preferably applied in the system according to the invention in order to ensure the reliability of the positioning data used to detect anomalous driving conditions.

[0026] Since the GPS receiver is influenced by measuring errors, the detection of events can be corrupted by incorrect data generated by the GPS receiver.

[0027] In order to improve the reliability of the detection of the events, the data acquired by the GPS receiver are preferably filtered to avoid false alarms and ensure a more robust detection of the events.

[0028] Firstly, the positioning data are filtered to eliminate the data acquired from the receiver in uncertain or poor quality positioning conditions. For this reason, the reliability parameters of the positioning data are compared with predetermined thresholds and the data are discarded if at least one of the parameters does not respect the relative threshold. An indicative example of the thresholds of the reliability parameters is given hereafter:

- 3D positioning
- HDOP < 5
- Number of satellites in view > 5
- Minimum CNO of the 3 satellites with strongest signal > 35dBHz

[0029] Moreover, detections that exceed the dynamics of the vehicle, inconsistency of the position change data of the vehicle with the speed data available on-board, sudden degradation of the power of the positioning signal received are further indications of the temporary unreliability of the measurements, for which reason the system temporarily suspends the acquisition of data from the GPS receiver.

[0030] In order to remove the possible noise by which the positioning data can be affected considering the dynamic limitations of the vehicle, a further filtering operation is applied. Experimentally, it has been found that a filter that provides a good balance between performance and complexity (computing cost) is a Butterworth filter of the second order, which obtains the relationship:

$$\begin{aligned} OutData(i) = & Input(i) * a(1) + Input(i-1) * a(2) + \\ & + Input(i-2) * a(3) - OutData(i-1) * b(2) + \\ & - OutData(i-2) * b(3) \end{aligned}$$

where *Input* and *Outdata* are generically the input and output entities (specifically *Input* represents the measurements of V and ω , *Outdata* represents the filtered values of V and ω), and

$$a(1)=0,020083, a(2)=0,040167, a(3)=0,020083$$

$$b(2)=-1.561, b(3)=0,64135$$

in the acquisition of linear speed measurements, or

$$a(1)=0,046132, a(2)=0,092264, a(3)=0,046132$$

$$b(2)=-1.3073, b(3)=0,49181$$

in the acquisition of angular speed measurements.

[0031] In the case of invalid positioning data the filter is reinitialized with the first available valid data, according to the relationships:

$$\begin{aligned} OutData(i) &= Input(i); \\ OutData(i-1) &= Input(i); \\ OutData(i-2) &= Input(i); \end{aligned}$$

[0032] If the positioning data are reliable, the system actuates the classification of the dynamic parameters monitored by comparison with predetermined detection thresholds of anomalous driving events in step 140 and checks whether the conditions of detection of a potentially dangerous anomalous driving condition are present, by comparison with a duration or time threshold of the anomalous events detected, as will be described in detail hereafter. If an anomalous driving condition is definitively detected (step 150) the system goes into the condition 160 of communication in real time of a warning signal, or of recording the event in view of a subsequent information communication to a remote monitoring station.

[0033] In the preferred embodiment, the system for detecting driving conditions according to the invention is provided to identify the following driving events or operations: harsh braking, harsh accelerations, changes in direction at high speed.

[0034] Using the GPS data it is possible to detect, in particular, the following dynamic conditions of the vehicle of interest:

- (1) vehicle braking, where the dominant dynamic component is a linear acceleration different from zero, negative or greatly negative;
- (2) vehicle in acceleration, where the dominant dynamic component is a linear acceleration different from zero, positive or greatly positive;
- (3) change in direction of travel of the vehicle in speed, where the dominant dynamic is a centripetal acceleration.

[0035] The detection of harsh driving operations is only carried out if the vehicle is travelling at a speed greater than a minimum threshold speed (for example 5 m/s), below which the detection of speed and direction by the GPS positioning system is no longer reliable and it certainly would not seem appropriate to talk of a "harsh" operation.

[0036] The condition (1) of harsh braking of the vehicle is detected for operations in which the vehicle is subjected to a negative acceleration in its direction of movement. The parameter identifying such an operation is deceleration Acc_B , defined as:

$$Acc_B = (V(t) - V(t - \tau)) / \tau$$

where τ is the GPS sampling period.

[0037] The condition of sudden deceleration or braking is therefore defined by the condition:

$$Acc_B < TH_B$$

occurring on n samples.

[0038] In a preferred embodiment, $TH_B = -3,6 \text{ m/s}^2$ and $n = 7$ (for GPS detections at a frequency of 5Hz).

[0039] The condition (2) of harsh acceleration of the vehicle is identified for operations in which the vehicle is subjected to a positive acceleration in its direction of movement. The parameter identifying such an operation is acceleration Acc , defined as:

$$Acc = (V(t) - V(t - \tau)) / \tau$$

where τ is the GPS sampling period.

[0040] The condition of harsh acceleration or start-up is therefore defined by the condition:

$$Acc > TH_A(V)$$

occurring on n samples.

[0041] It should be noted that the maximum possible acceleration of the vehicle varies as the speed of the vehicle (and the transmission ratio inserted) varies, for which reason the acceleration threshold suitable for detecting a condition of harsh acceleration is preferably defined as a function of the speed of the vehicle, for example according to a simple relationship shown in figure 4, and identified by just two pairs of acceleration/speed parameters:

$$Acc_1 @ V_1$$

$$Acc_2 @ V_2$$

5 **[0042]** If the travelling speed of the vehicle is less than V_2 , the acceleration threshold TH_A is determined according to a linear function

$$10 \quad TH_A(V) = m * V + b$$

where $m = (Acc_2 - Acc_1)/(V_2 - V_1)$ and $b = Acc_2 - m * V_2$

[0043] If the travelling speed of the vehicle is equal to or greater than V_2 , the acceleration threshold TH_A is constant and equal to Acc_2 .

15 **[0044]** In a preferred embodiment, $Acc_1 = 2,6 \text{ m/s}^2 @ V_1 = 3 \text{ m/s}$ and $Acc_2 = 0,5 \text{ m/s}^2 @ V_2 = 35 \text{ m/s}$, with $n = 12$ (for GPS detections at a frequency of 5Hz).

[0045] The condition (3) of harsh change in direction of the vehicle is identified for operations in which the driver turns with an excessive angular speed with respect to the current travel speed. The parameter identifying such an operation is centripetal acceleration Acc_c , defined as:

$$20 \quad Acc_c = V * \omega \quad [m/s^2]$$

25 where V is the linear speed, expressed in $[m/s]$ and ω is the angular speed, expressed in $[rad/s]$, the latter derived from the travel direction (θ) provided by the receiver R according to the relationship:

$$30 \quad \omega = (\theta(t) - \theta(t - \tau)) / \tau$$

where τ is the GPS sampling period.

[0046] Considering that the travelling speed V of the vehicle can vary between two sampling instants of the positioning signal (of the GPS receiver) it is possible to approximate the travel speed V of the vehicle when turning with a constant average speed in the sampling period

$$35 \quad V_m = (V(t) + V(t - \tau))/2$$

40 **[0047]** The condition of harsh turning is therefore defined by the condition:

$$|Acc_c(t)| > TH_T$$

45 for $0 < t < T$, T overall duration of the operation the minimum value of which corresponds to two sampling periods.

[0048] In a preferred embodiment, $TH_T = 4,5 \text{ m/s}^2$ and T corresponds to 12 sampling periods (for GPS detections at a frequency of 5Hz).

50 **[0049]** In an improved embodiment it is also possible to foresee the detection of multiple consecutive harsh turning operations of short duration (so-called "S" manoeuvres), but this cannot be obtained with the same control logic of the simple turning operation, since in the case of successive turns whenever the change in direction is inverted the method for detecting the driving condition is reset.

[0050] Figure 3b shows the detailed flow diagram of the operations for detecting harsh driving operations, generally indicated with 140 in figure 3a.

55 **[0051]** Every manoeuvring condition monitored is subjected to the same detection logic.

[0052] From the positioning data acquired from the GPS receiver R and adjudged reliable the linear acceleration and centripetal acceleration values are calculated. The calculated linear acceleration values are compared in steps 1401

and 1402, respectively, with the start-up and braking thresholds TH_A and TH_B , the centripetal acceleration value is compared in step 1403 with the relative threshold TH_T .

[0053] For every driving condition monitored a respective events counter is defined.

[0054] If the acceleration value considered exceeds the predetermined threshold, i.e. the outcome of the comparison is positive, the respective events counter is incremented (steps 1411, 1412, 1413). If the acceleration value considered does not exceed the predetermined threshold, the outcome of the comparison is negative, the respective events counter is decremented, at the limit until it is zeroed (steps 1421, 1422, 1423).

[0055] For every driving condition monitored a counting threshold TH_{count} of the detected events is defined, and only when the counter of events exceeds the respective counting threshold, a condition that is verified in steps 1431, 1432 and 1433, the operation is detected as a harsh operation (steps 1441, 1442, 1443). In the case of harsh turning operations, the sign information of the centripetal acceleration value is taken into account to identify the turning direction, and the inversion of sign determines the resetting of the events counter. Advantageously, after the detection of an event, the counter is zeroed when a subsequent detected acceleration value goes back below the predetermined threshold value, so as to allow the detection of successive events.

[0056] Advantageously, the step of incrementing each events counter is imposed at a different value from, and substantially greater than, the step of decrementing the same counter, so as to detect as anomalous also driving conditions in which the harsh operation is suspended for a short time period, to then start again, like in the case of a start-up operation in which the acceleration impressed on the vehicle stops at the moments when a gear change is carried out.

[0057] For example, in the case of a start-up operation, to improve the ability to detect a harsh acceleration operation the events counter is incremented by a value equal to 1 every time the calculated linear acceleration exceeds the predetermined threshold, but it is decremented by a value equal to 0.2 every time the calculated linear acceleration does not exceed the predetermined threshold.

[0058] The diagrams of figures 5a and 5b clearly show, for a start-up operation with gear change, the evolution over time of the acceleration impressed to the vehicle (curve A) compared with the relative threshold TH_A , for which reason each time the threshold is exceeded determines the detection of an anomalous dynamic condition, as well as the evolution over time of the counting of events identifying an anomalous dynamic condition (curve E) with respect to the warning or alarm threshold TH_{count} that qualifies the operation as a harsh operation.

[0059] The first samples are not considered valid due to the low speed of the vehicle. When, in step 1401 the acceleration is detected as above the threshold value TH_A defined for the current speed of the vehicle, the events counter increments its count in step 1411. The increment stops (after 19 seconds) when the acceleration value falls below the threshold through a gear change (comparison in step 1401), and the counter begins to decrement its count (step 1421), at a lower rate than the increment rate. Once the second gear is engaged the vehicle starts to accelerate again for which reason the detected acceleration value once again exceeds the threshold TH_A (comparison in step 1401) and the events counter starts to increment its count again (step 1411) until the counting threshold TH_{count} is exceeded (comparison in step 1431), when the warning condition, due to the harsh acceleration operation, is detected (step 1441). The counter is then zeroed when the detected acceleration goes back below the threshold value after the detection of the event, so as to allow the detection of subsequent events.

[0060] In this way, the system provides a more accurate detection of the operation with respect to a rough method that bases the detection of a harsh operation simply on whether a threshold value of the acceleration has been exceeded, and that would involve risks of uncertainty of the decision in the case in which, as shown, the real acceleration fluctuates around the decision threshold TH_A .

[0061] The diagrams of figures 6a and 6b show an example of detection of a harsh turning operation, by comparison with the diagrams of figures 7a and 7b, in which an example of a turning operation is shown that does not last sufficiently long for the events counter to determine the detection of a warning condition.

[0062] When the centripetal acceleration (curve A) is detected above the threshold value TH_T in step 1403 the events counter increments its count (curve E) in step 1413. The increment stops for a short time period during the manoeuvre when the acceleration value falls below the threshold (comparison in step 1403) for which reason the counter starts to decrement its count (step 1423), at a lower rate than the increment rate. Thereafter, when the centripetal acceleration is once again detected as above the threshold TH_T in step 1403 the events counter starts to increment its count again (step 1413) until the counting threshold TH_{count} is exceeded (comparison in step 1433), when the warning condition, due to the harsh turning operation, is detected (step 1443). The counter is then zeroed when the detected acceleration goes back below the threshold value after the detection of the event, so as to allow the detection of subsequent events.

[0063] With reference to the diagrams of figures 7a and 7b, when the centripetal acceleration (curve A) is detected to be above to threshold value TH_T in step 1403 the events counter increments its count (curve E) in step 1413. The increment stops when the acceleration value falls below the threshold (comparison in step 1403) for which reason the counter starts to decrement its count (step 1423), at a lower rate than the increment rate, before having reached the counting threshold TH_{count} (comparison in step 1433), for which reason a warning condition is not detected. The figures also show the behaviour of the system in the case of an unreliable sample, indicated with F. Advantageously, the count

of the events counter is immediately zeroed and the detection method is reset, so that no false detection can be incorrectly detected or recorded.

[0064] Advantageously, as shown in the above description, the method for detecting harsh driving operations according to the invention, through the double threshold verification, carried out on the value of the entity representative of a dynamic condition of the vehicle to discriminate an anomalous driving event, and on how long an anomalous driving condition has lasted by aggregation of anomalous driving events, allows effective identification of the warning conditions, avoiding the occurrence of false alarms or the repeated indication of alarms depending on a single harsh operation, carried out with discontinuity in a short time period.

[0065] Of course, without affecting the principle of the invention, the embodiments and the details can be greatly varied with respect to what has been described and illustrated purely as a non-limiting example, without for this reason departing from the scope of protection of the invention defined by the attached claims.

Claims

1. A method for detecting harsh driving operations of a vehicle (V), comprising the steps of:

- acquiring (110) data indicative of at least an entity representing the dynamic behaviour of the vehicle (V) at predetermined sampling times; and
- comparing (1401, 1402, 1403) said data with a predetermined corresponding threshold value, adapted to distinguish an anomalous driving event;

wherein when the acquired data exceed the corresponding threshold value a counter of anomalous driving events is incremented (1411, 1412, 1413), said counter being decremented (1421, 1422, 1423) from a non-zero value when the acquired data do not exceed the threshold value, and a harsh operation is detected (150) when the counter of anomalous driving events exceeds (1431, 1441; 1432, 1442; 1433, 1443) a predetermined warning threshold **characterised in that** the incrementing step of the counter of anomalous driving events is greater than the decrementing step of said counter.

2. A method according to Claim 1, wherein the data indicative of the dynamic behaviour of the vehicle (V) comprise a plurality of entities representing the dynamic behaviour of the vehicle (V) including the linear and centripetal accelerations to which the vehicle is subject, said accelerations being indicative of a first driving condition of vehicle braking, of a second driving condition of start-up acceleration of the vehicle and of a third driving condition of change of the travelling direction of the vehicle.

3. A method according to any one of the preceding claims, wherein the predetermined threshold value adapted to distinguish an anomalous driving event is adjustable as a function of the travelling speed of the vehicle (V).

4. A method according to any one of the preceding claims, **characterised in that** it is reset whenever are acquired data indicative of the dynamic behaviour of the vehicle (V) that are not reliable.

5. A method according to any one of the preceding claims, **characterised in that** it is carried out if the travelling speed of the vehicle (V) is greater than a minimum threshold speed.

6. A method according to any one of the preceding claims, comprising computing the data indicative of the dynamic behaviour of the vehicle (V) based on satellite positioning data of the vehicle.

7. A method according to any one of the preceding claims, comprising detecting the data indicative of the dynamic behaviour of the vehicle (V) by onboard inertial sensor devices.

8. A method according to any one of the preceding claims, comprising detecting the data indicative of the dynamic behaviour of the vehicle (V) by onboard odometric sensors.

9. A system for monitoring the driving conditions of a vehicle, comprising processing means (E) arranged for acquiring data representing the vehicle (V) dynamics and programmed for carrying out a method according to any one of claims 1 to 8 and for triggering a warning about an anomalous driving condition (160), including storing or transmitting to a remote station the data representing the vehicle dynamics, when a harsh operation is detected.

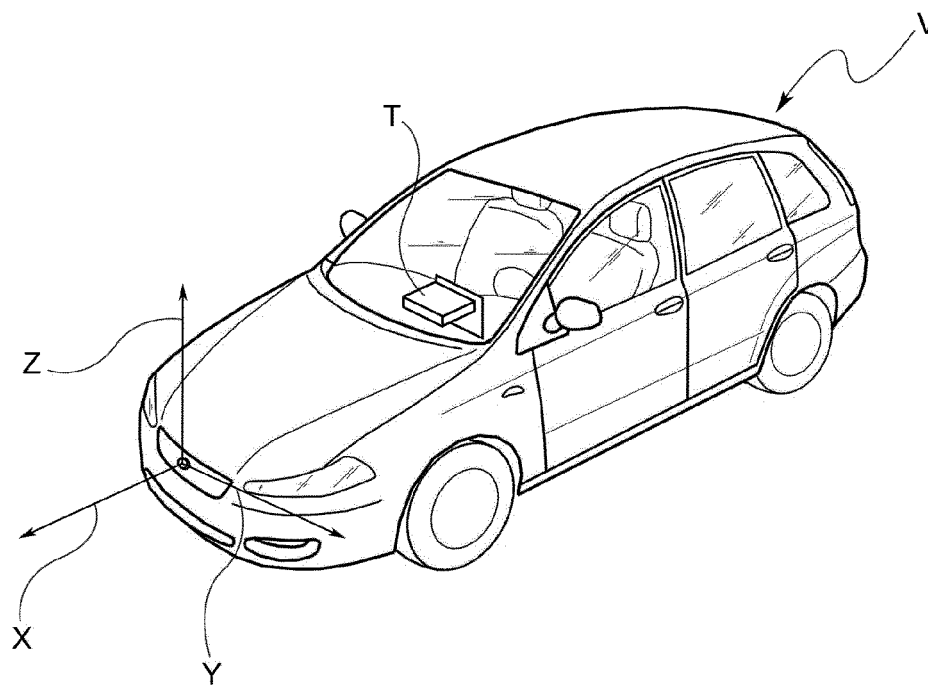


FIG. 1

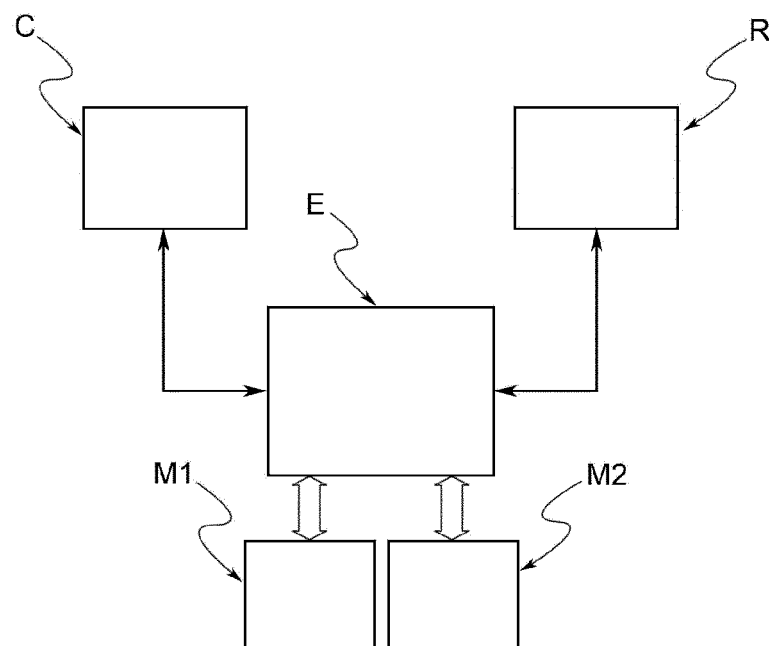


FIG. 2

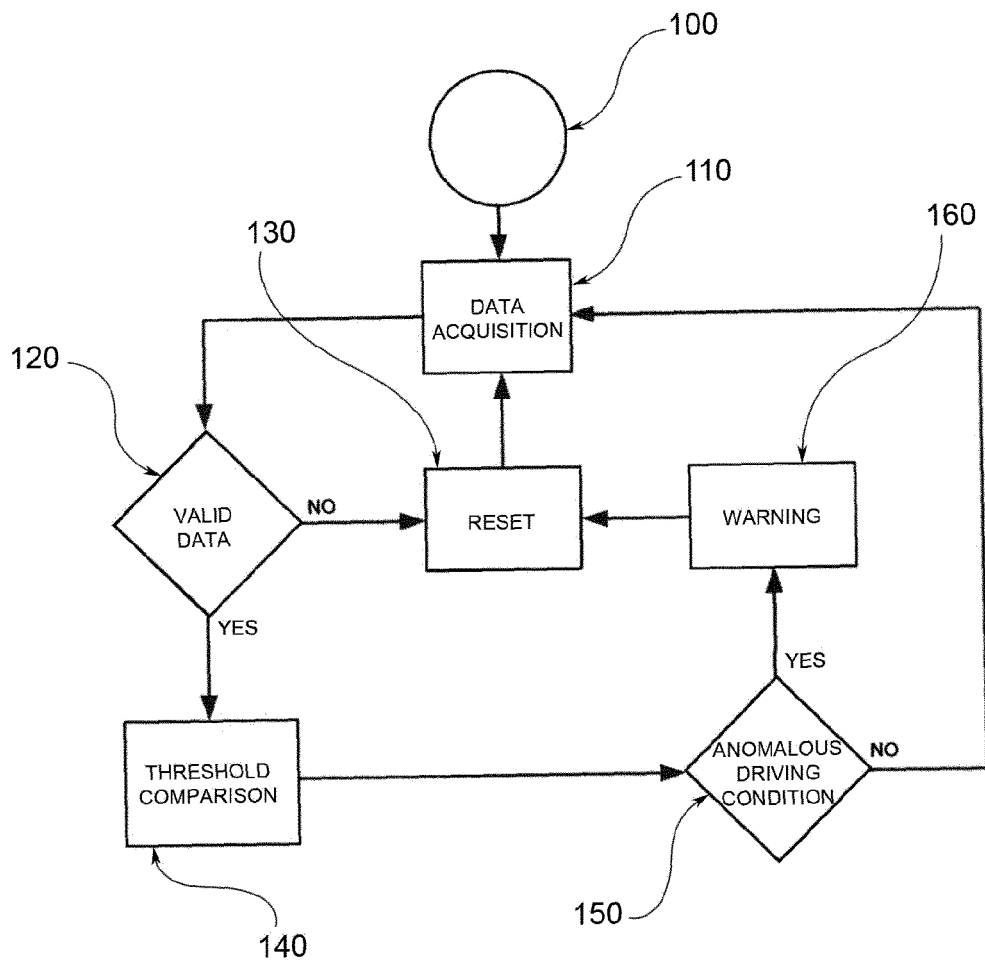


FIG. 3a

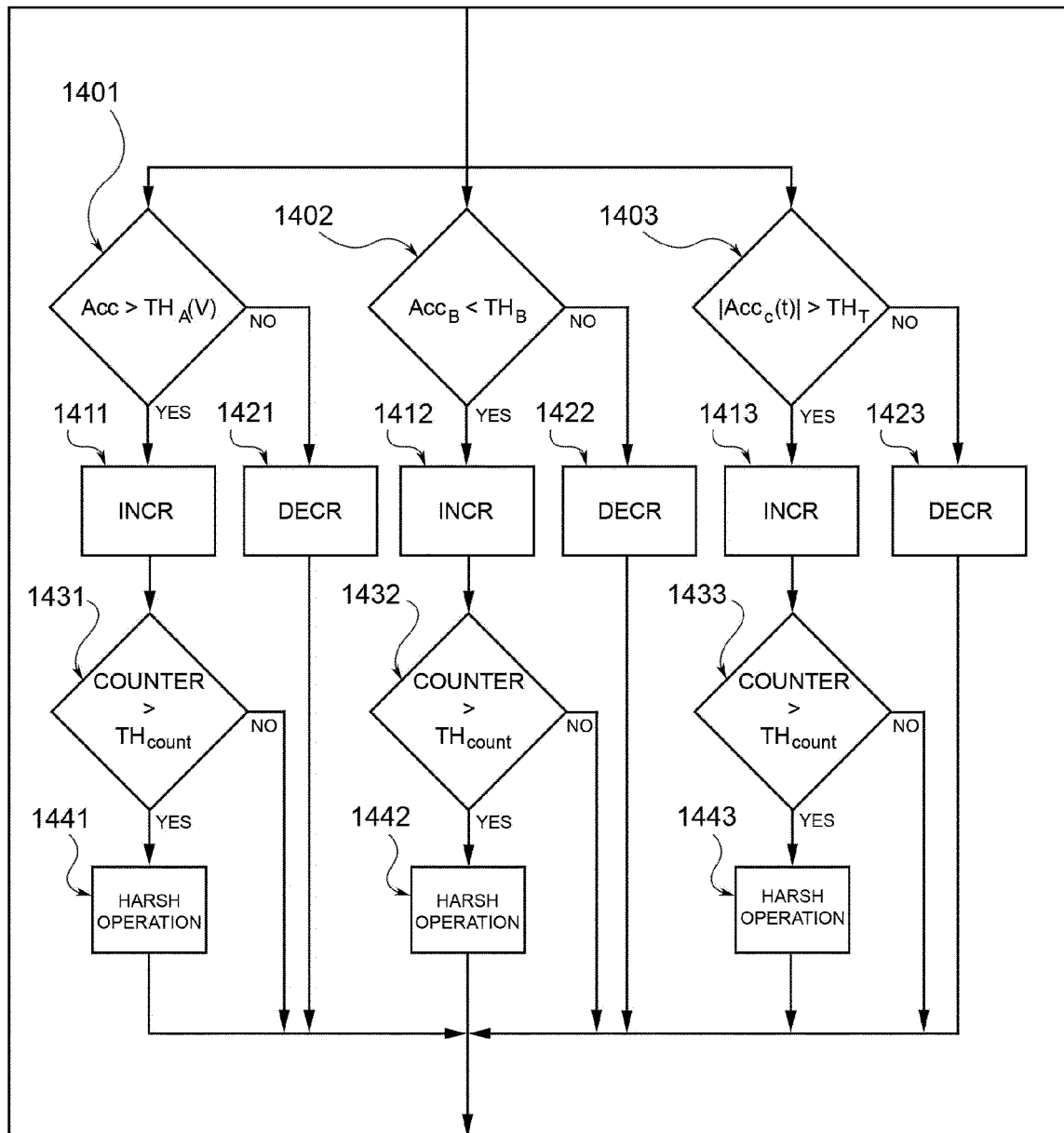


FIG. 3b

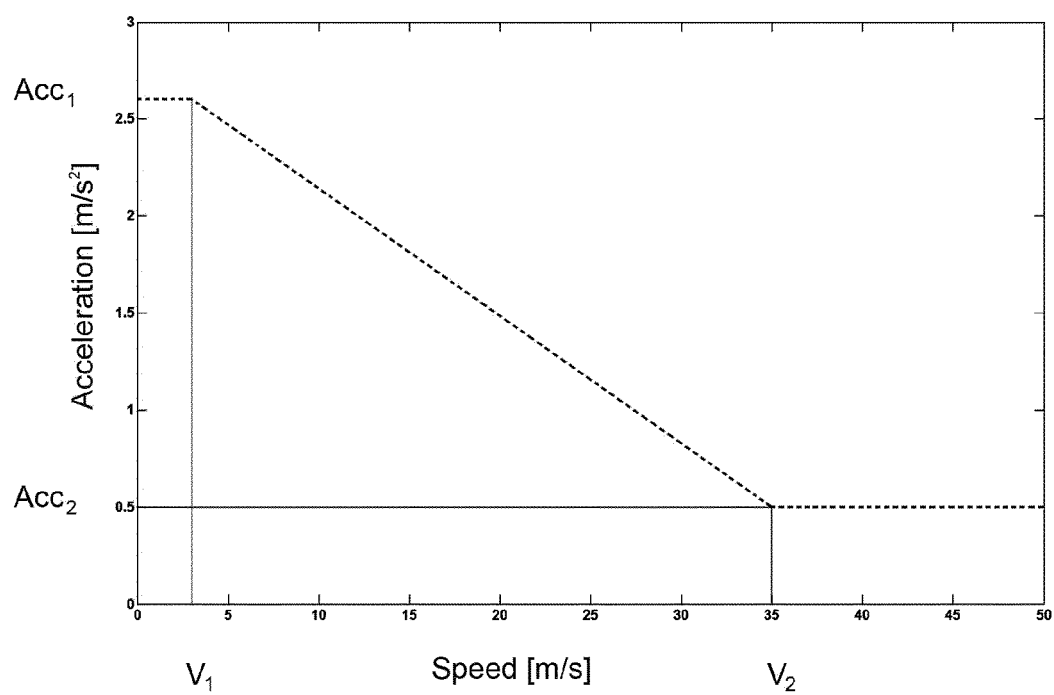


FIG. 4

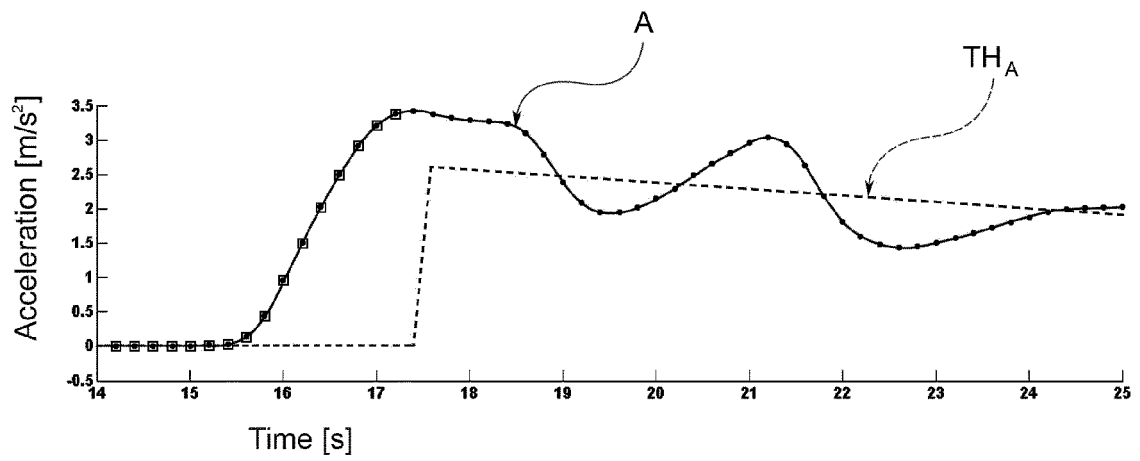


FIG. 5a

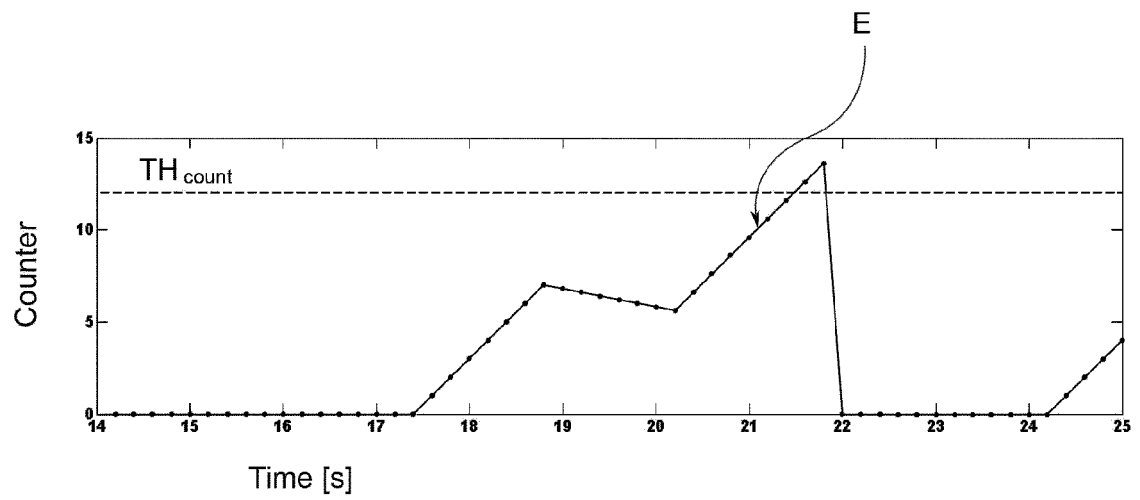


FIG. 5b

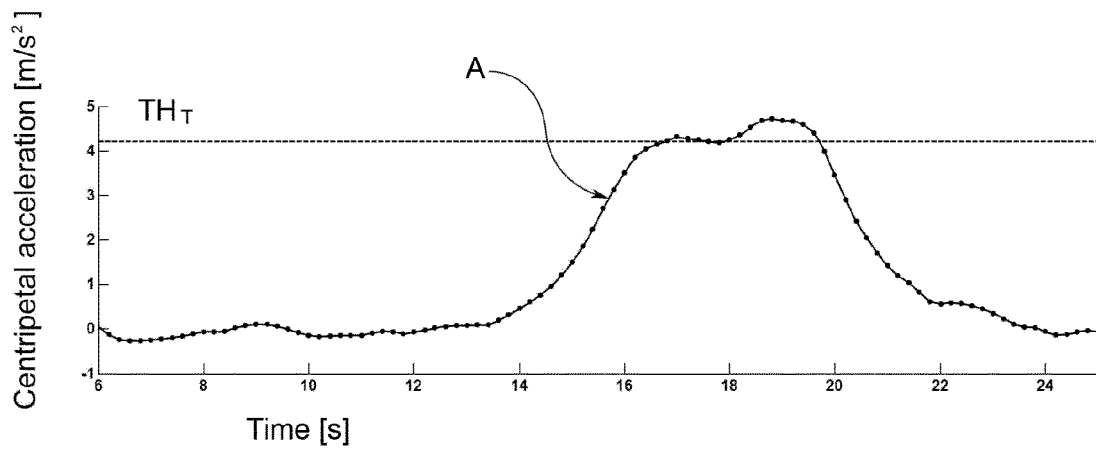


FIG. 6a

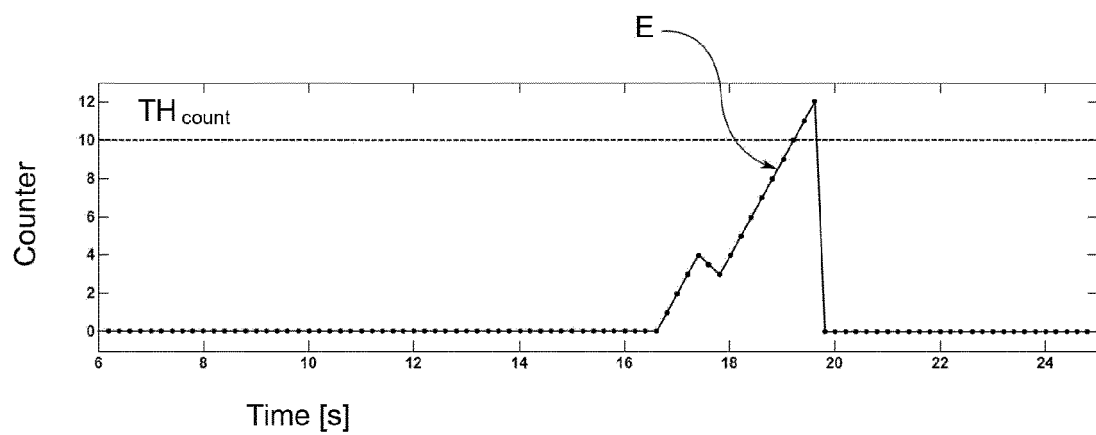


FIG. 6b

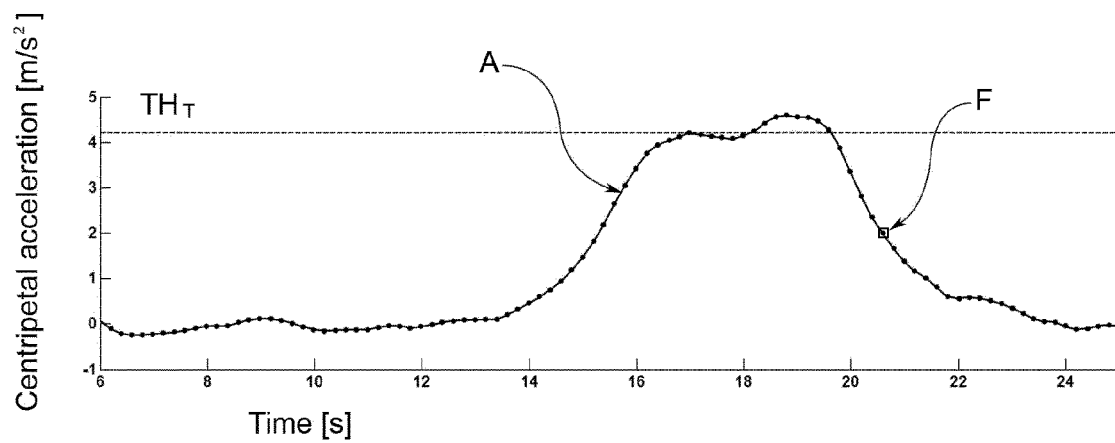


FIG. 7a

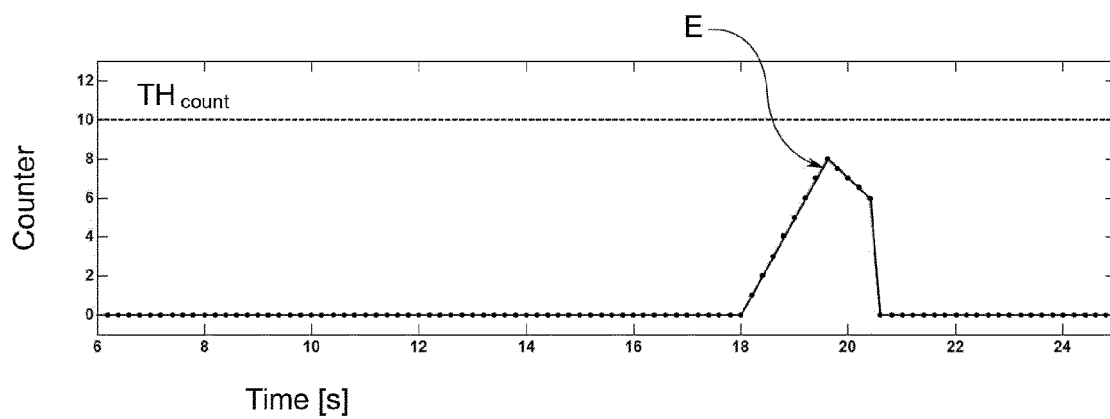


FIG. 7b



EUROPEAN SEARCH REPORT

Application Number
EP 11 19 5153

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 4 500 868 A (TOKITSU NAOKI [JP] ET AL) 19 February 1985 (1985-02-19) * abstract * * column 1, line 5 - line 63 * * column 4, line 24 - line 42 * * column 5, line 20 - column 6, line 12 * * figure ALL *	1-9	INV. G07C5/00 G07C5/08
A	WO 2005/003885 A2 (WAY SAFER TECHNOLOGIES LTD [IL]; TAMIR ASAF [IL]; TOPAZ IDO [IL]) 13 January 2005 (2005-01-13) * abstract * * page 11, line 20 - line 23 * * figure 1 *	1-9	
A	EP 2 169 635 A1 (FSD FAHRZEUGSYSTEMDATEN GMBH [DE]) 31 March 2010 (2010-03-31) * abstract *	1,3,9	
A	US 2003/158649 A1 (HASHIMOTO KOHJI [JP] ET AL) 21 August 2003 (2003-08-21) * paragraph [0032] - paragraph [0034] * * paragraph [0253] *	1,9	TECHNICAL FIELDS SEARCHED (IPC) G07C
A	US 5 465 079 A (BOUCHARD PAUL J [US] ET AL) 7 November 1995 (1995-11-07) * abstract * * column 9, line 39 - line 46 *	1,2,4,7,9	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 7 March 2012	Examiner Mandato, Davide
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 11 19 5153

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

07-03-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4500868 A	19-02-1985	DE 3146711 A1	24-06-1982
		JP 1673623 C	26-06-1992
		JP 3018127 B	11-03-1991
		JP 57090106 A	04-06-1982
		US 4500868 A	19-02-1985
WO 2005003885 A2	13-01-2005	CA 2531662 A1	13-01-2005
		EP 1652128 A2	03-05-2006
		US 2007027583 A1	01-02-2007
		US 2010332266 A1	30-12-2010
		WO 2005003885 A2	13-01-2005
EP 2169635 A1	31-03-2010	DE 102008047727 A1	25-03-2010
		EP 2169635 A1	31-03-2010
US 2003158649 A1	21-08-2003	CN 1439973 A	03-09-2003
		DE 10243589 A1	04-09-2003
		JP 3842144 B2	08-11-2006
		JP 2003247453 A	05-09-2003
		US 2003158649 A1	21-08-2003
US 5465079 A	07-11-1995	NONE	