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

Verfahren zur Erfassung von schroffen Fahrbetrieb eines Fahrzeugs und ein System zur Überwachung der Fahrbedingungen eines Fahrzeugs

Méthode pour détecter les opérations brusques de conduite d'un véhicule et un système pour surveiller les conditions de conduite d'un véhicule

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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] US 4 500 868 discloses an automotive driving instruction system which comprises a plurality of sensors and a computer for calculating the driving conditions of the automobile on the basis of the outputs of the sensors.

[0006] WO 2005/003885 discloses a method of evaluating the driving behaviour in a vehicle through comparison of values of a plurality of parameters of the operation of the vehicle with those of one or more other vehicles.

[0007] EP 2 169 635 discloses a driver assistance system and a method for identifying critical driving situations by recording of measuring data of a sensor system relevant to a driving situation.

[0008] US 2003/158649 discloses a vehicular electronic control apparatus that is used for fuel supply control of a vehicle engine.

[0009] US 5 465 079 discloses a method and apparatus for evaluating a driver's performance under actual real-time conditions and for using such evaluations to determine the driver's ability to safely operate a vehicle.

[0010] 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 optionally 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.

[0011] 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.

[0012] 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.

[0013] A further object of the invention is a system for monitoring the driving conditions of a vehicle, having the characteristics outlined in claim 9.

[0014] 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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.

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] 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.

[0031] Since the GPS receiver is influenced by measuring errors, the detection of events can be corrupted by incorrect data generated by the GPS receiver.

[0032] 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.

[0033] 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

[0034] 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.

[0035] 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.

[0036] In the case of invalid positioning data the filter is reinitialized with the first available valid data, according to the relationships:

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

[0037] 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.

[0038] 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.

[0039] 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.

[0040] 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.

[0041] 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.

[0042] The condition of sudden deceleration or braking is therefore defined by the condition:

$$Acc_B < TH_B$$

occurring on n samples.

[0043] In a preferred embodiment, $TH_B = -3,6 \text{ m/s}^2$ and $n = 7$ (for GPS detections at a frequency of 5Hz).

[0044] 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.

[0045] The condition of harsh acceleration or start-up is therefore defined by the condition:

$$Acc > TH_A(V)$$

occurring on n samples.

[0046] 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:

$$Acc_1 @ V_1$$

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$$Acc_2 @ V_2$$

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[0047] If the travelling speed of the vehicle is less than V_2 , the acceleration threshold TH_A is determined according to a linear function

$$TH_A(V) = m * V + b$$

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

[0048] 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 .

[0049] 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).

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[0050] 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:

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

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:

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

where τ is the GPS sampling period.

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[0051] 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

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

[0052] The condition of harsh turning is therefore defined by the condition:

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

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

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[0053] 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).

[0054] 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.

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[0055] Figure 3b shows the detailed flow diagram of the operations for detecting harsh driving operations, generally indicated with 140 in figure 3a.

[0056] Every manoeuvring condition monitored is subjected to the same detection logic.

[0057] 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 .

[0058] For every driving condition monitored a respective events counter is defined.

[0059] 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).

[0060] 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.

[0061] 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.

[0062] 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.

[0063] 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.

[0064] 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.

[0065] 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 .

[0066] 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.

[0067] 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.

[0068] 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.

[0069] 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.

[0070] 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) each of said data with a predetermined corresponding threshold value, adapted to distinguish an anomalous driving event;

wherein when one of the acquired data exceeds the corresponding threshold value a respective counter of anomalous driving events is incremented (1411, 1412, 1413), said counter being decremented (1421, 1422, 1423) from a non-zero value when said one of the acquired data does not exceed the corresponding threshold value, and a harsh operation is detected (150) when at least one of the counters of anomalous driving events exceeds (1431, 1441; 1432, 1442; 1433, 1443) a predetermined warning threshold, the method being further **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** another acquisition of said data is performed whenever the acquired data 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.

10. A system according to Claim 9, wherein said processing means (E) are further arranged 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.

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Patentansprüche

1. Verfahren zur Erfassung von schroffem Fahrbetrieb eines Fahrzeugs (V), das folgende Schritte beinhaltet:

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- Erfassen (110) von Daten, die auf mindestens eine das dynamische Verhalten des Fahrzeugs (V) an vorgegebenen Abtastzeitpunkten repräsentierende Einheit hinweisen; und
 - Vergleichen (1401, 1402, 1403) jedes dieser Daten mit einem vorgegebenen entsprechenden Schwellenwert, angepasst, ein ungewöhnliches Fahrereignis zu erkennen;

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- wobei, wenn eines der erfassten Daten den entsprechenden Schwellenwert überschreitet, ein entsprechender Zähler von ungewöhnlichen Fahrereignissen aufwärts gezählt wird (1411, 1412, 1413), während der Zähler ab einem anderen Wert als Null abwärts gezählt wird (1421, 1422, 1423), wenn das eine der erfassten Daten den entsprechenden Schwellenwert nicht überschreitet, und

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- ein schroffer Betrieb erfasst wird (150), wenn mindestens einer der Zähler von ungewöhnlichen Fahrereignissen eine vorgegebene Warnschwelle überschreitet (1431, 1441; 1432, 1442; 1433, 1443), wobei das Verfahren ferner **dadurch**

gekennzeichnet ist, dass der Aufwärtsschritt des Zählers von ungewöhnlichen Fahrereignissen größer als der Abwärtsschritt des Zählers ist.

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2. Verfahren nach Anspruch 1, wobei die auf das dynamische Verhalten des Fahrzeugs (V) hinweisenden Daten eine Vielzahl von Einheiten aufweisen, die das dynamische Verhalten des Fahrzeugs (V) einschließlich der linearen und zentripetalen Beschleunigungen, denen das Fahrzeug ausgesetzt ist, repräsentieren, wobei die Beschleunigungen auf eine erste Fahrbedingung des Abbremsens des Fahrzeugs, auf eine zweite Fahrbedingung der Anfahrbeschleunigung des Fahrzeugs und auf eine dritte Fahrbedingung einer Änderung der Fahrtrichtung des Fahrzeugs hinweisen.

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3. Verfahren nach einem der vorangegangenen Ansprüche, wobei der vorgegebene Schwellenwert, der angepasst ist, ein ungewöhnliches Fahrereignis zu erkennen, abhängig von der Fahrtgeschwindigkeit des Fahrzeugs (V) einstellbar ist.

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4. Verfahren nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** eine weitere Erfassung der Daten immer dann durchgeführt wird, wenn die erfassten Daten nicht zuverlässig sind.

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5. Verfahren nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** es durchgeführt wird, falls die Fahrtgeschwindigkeit des Fahrzeugs (V) größer als eine minimale Schwellengeschwindigkeit ist.

6. Verfahren nach einem der vorangegangenen Ansprüche, mit Berechnen der auf das dynamische Verhalten des Fahrzeugs (V) hinweisenden Daten auf der Basis von Satellitennavigationsdaten des Fahrzeugs.

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7. Verfahren nach einem der vorangegangenen Ansprüche, mit Erfassen der auf das dynamische Verhalten des Fahrzeugs (V) hinweisenden Daten durch an Bord befindliche Trägheitssensorvorrichtungen.

- 50
8. Verfahren nach einem der vorangegangenen Ansprüche, mit Erfassen der auf das dynamische Verhalten des Fahrzeugs (V) hinweisenden Daten durch an Bord befindliche Wegstreckenmesssensoren.

9. System zum Überwachen der Fahrtbedingungen eines Fahrzeugs, mit einer Verarbeitungseinrichtung (E), die für das Erfassen von die Dynamik des Fahrzeugs (V) repräsentierenden Daten angeordnet und für das Durchführen eines Verfahrens nach einem der Ansprüche 1 bis 8 programmiert ist.

- 55
10. System nach Anspruch 9, wobei die Verarbeitungseinrichtung (E) ferner für das Auslösen einer Warnung vor einer ungewöhnlichen Fahrbedingung (160), einschließlich Speichern oder Senden der die Fahrzeugdynamik repräsentierenden Daten zu einer entfernten

Station, angeordnet ist.

Revendications

1. Procédé pour la détection des opérations brusques de conduite d'un véhicule (V), comprenant les étapes de:

- acquisition (110) de données indiquant au moins une entité représentant le comportement dynamique du véhicule (V) à des temps d'échantillonnage prédéterminés; et
- comparaison (1401, 1402, 1403) de chacune desdites données avec une valeur de seuil correspondante prédéterminée, appropriée pour distinguer un événement de conduite anormal;

tandis que quand l'une des données acquises dépasse la valeur de seuil correspondante un compteur respectif d'événements de conduite anormaux est incrémenté (1411, 1412, 1413), ledit compteur étant décrémenté (1421, 1422, 1423) à partir d'une valeur non-zéro lorsque ladite une des données acquises ne dépasse pas la valeur de seuil correspondante, et une opération brusque est détectée (150) quand au moins l'un des compteurs d'événements de conduite anormaux dépasse (1431, 1441; 1432, 1442; 1433, 1443) un seuil d'alerte prédéterminé, le procédé étant en outre **caractérisé en ce que** l'étape d'incrémentation du compteur d'événements de conduite anormaux est supérieure à l'étape de décrémentement dudit compteur.

2. Procédé selon la revendication 1, dans lequel les données indicatrices du comportement dynamique du véhicule (V) comprennent une pluralité d'entités représentant le comportement dynamique du véhicule (V) incluant les accélérations linéaire et centripète auxquelles le véhicule est soumis, lesdites accélérations étant indicatrices d'une première condition de commande du freinage du véhicule, d'une deuxième condition de commande de l'accélération de démarrage du véhicule et d'une troisième condition de commande de la direction de déplacement du véhicule.

3. Procédé selon l'une quelconque des revendications précédentes, dans lequel la valeur de seuil prédéterminée adaptée à la distinction d'un événement de conduite anormal est ajustable en fonction de la vitesse de déplacement du véhicule (V).

4. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** qu'une autre acquisition desdites données est effectuée lorsque les données acquises ne sont pas fiables.

5. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'il** est mis en oeuvre si la vitesse de déplacement du véhicule (V) est supérieure à une vitesse de seuil minimale.

6. Procédé selon l'une quelconque des revendications précédentes, comprenant le calcul des données indicatrices du comportement dynamique du véhicule (V) sur la base de données de positionnement par satellite du véhicule.

7. Procédé selon l'une quelconque des revendications précédentes, comprenant la détection des données indicatrices du comportement dynamique du véhicule (V) par des dispositifs capteurs inertiels embarqués.

8. Procédé selon l'une quelconque des revendications précédentes, comprenant la détection des données indicatrices du comportement dynamique du véhicule (V) par des capteurs odométriques embarqués.

9. Système pour le contrôle des conditions de conduite d'un véhicule, comprenant des moyens de mise en oeuvre (E) agencés pour l'acquisition de données représentant la dynamique du véhicule (V) et programmés pour l'exécution d'un procédé selon l'une quelconque des revendications 1 à 8.

10. Système selon la revendication 9, dans lequel lesdits moyens de mise en oeuvre (E) sont en outre agencés pour déclencher une alerte concernant une condition de conduite anormale (160), y compris la mémorisation ou la transmission à un emplacement éloigné des données représentant la dynamique du véhicule, lorsqu'une opération brusque est détectée.

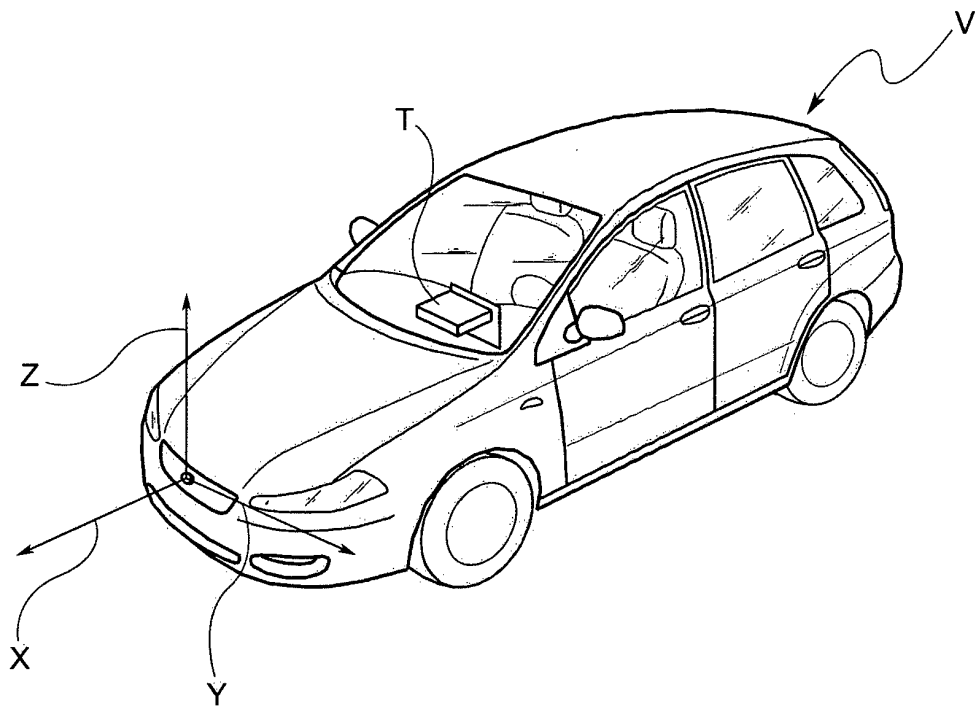


FIG. 1

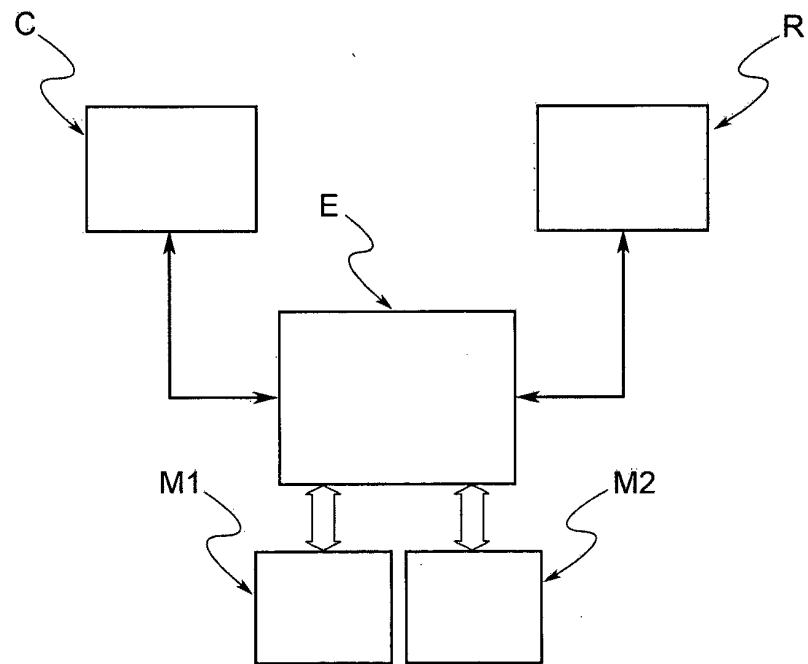


FIG. 2

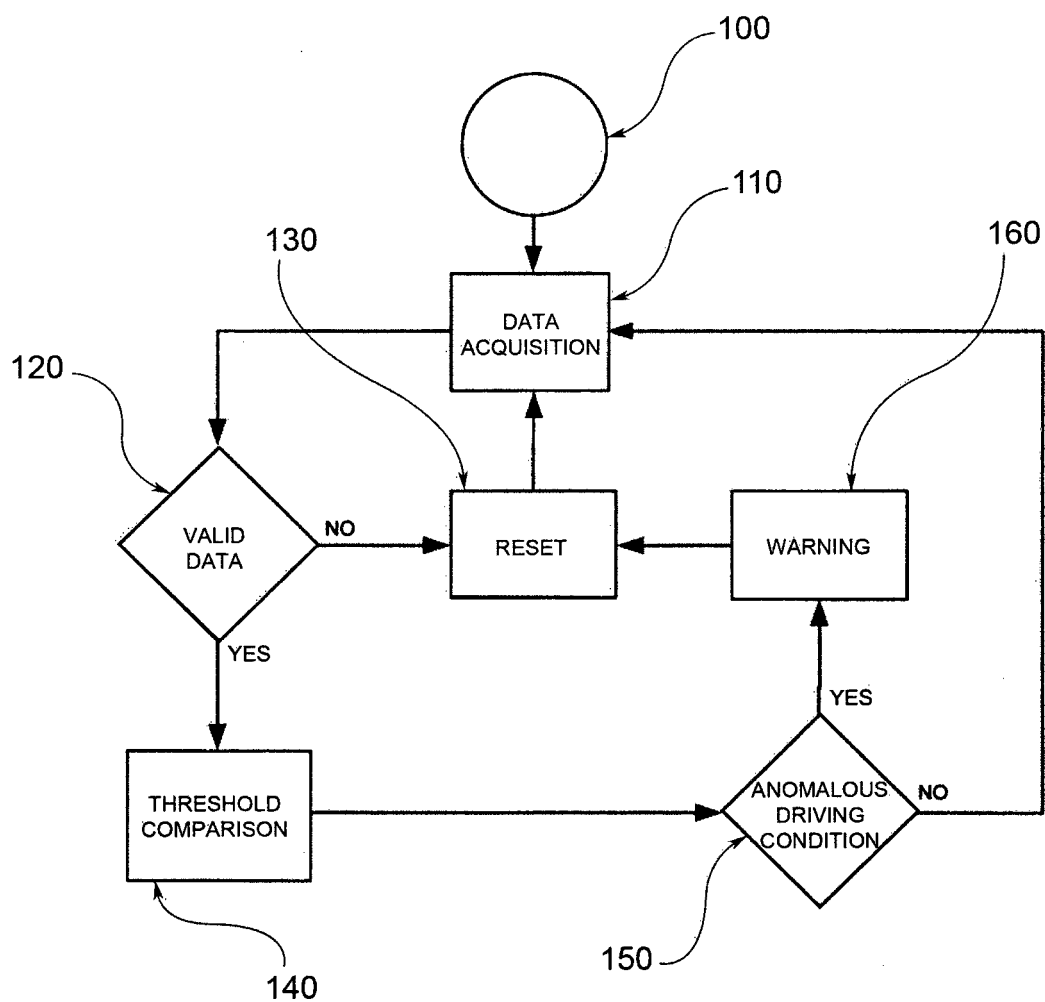


FIG. 3a

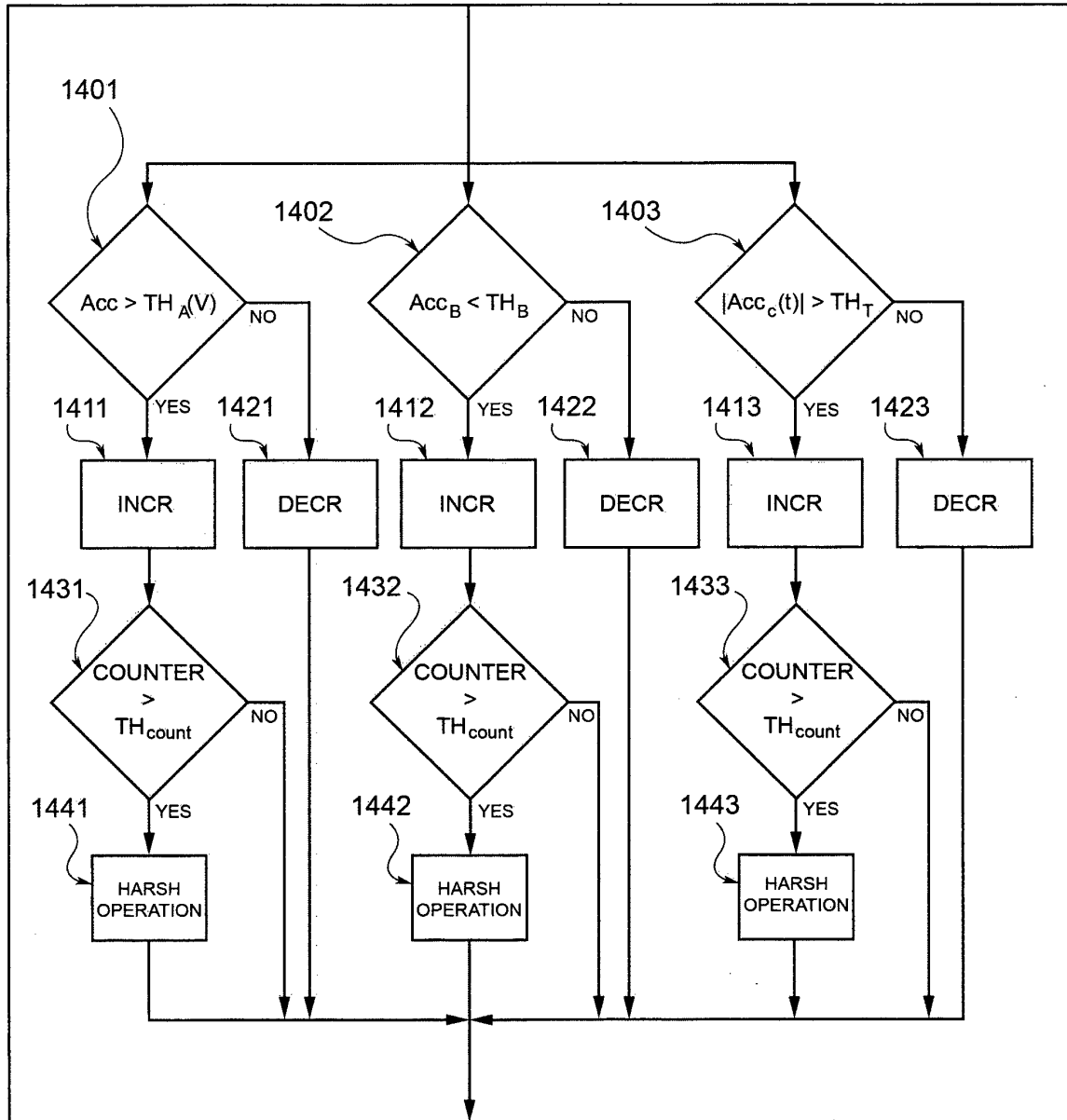


FIG. 3b

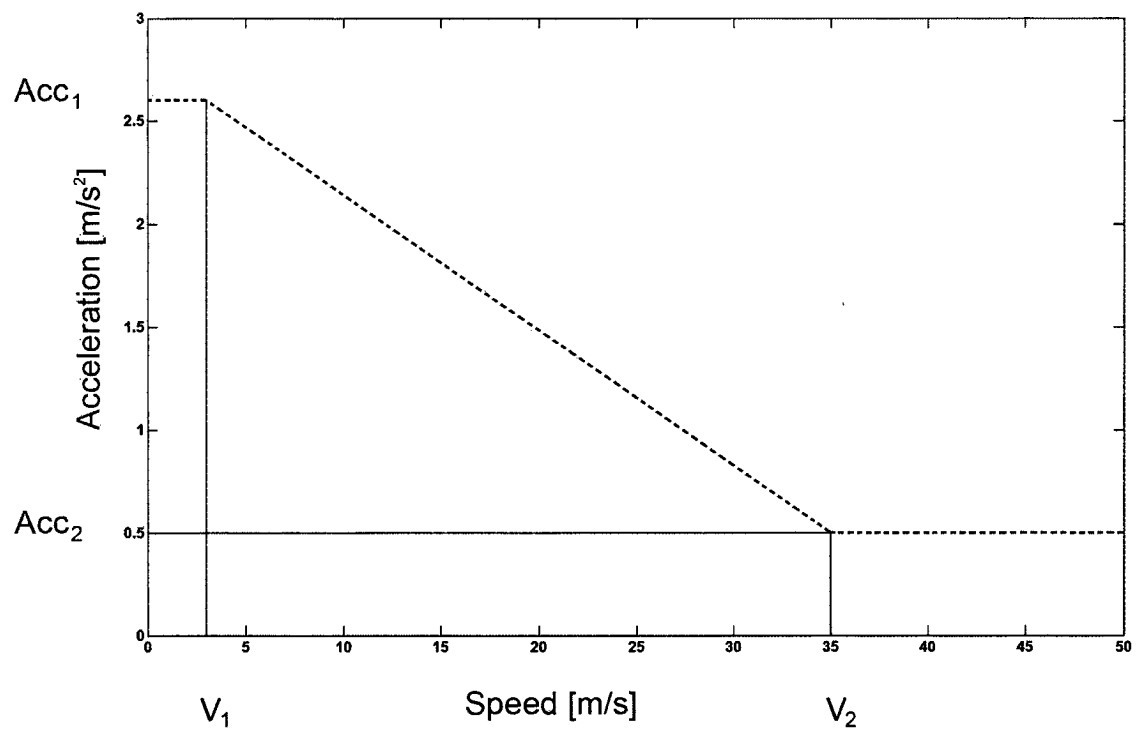


FIG. 4

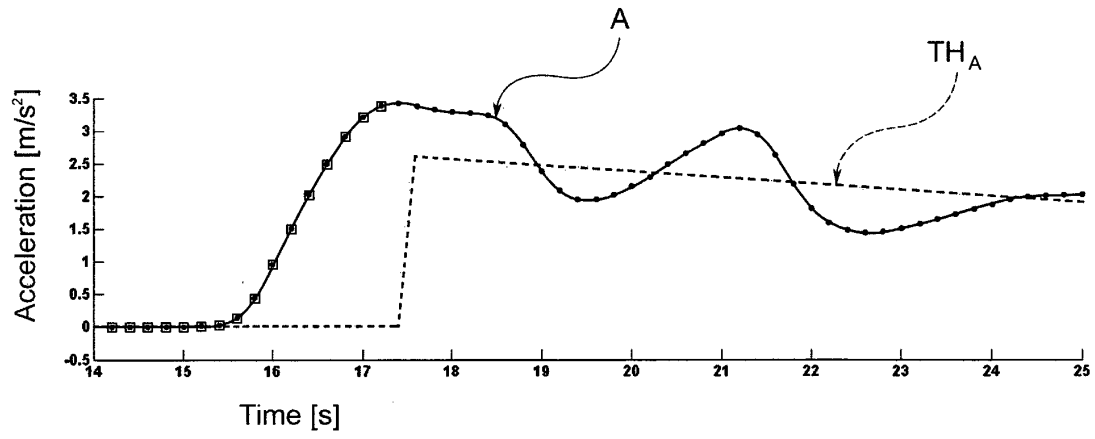


FIG. 5a

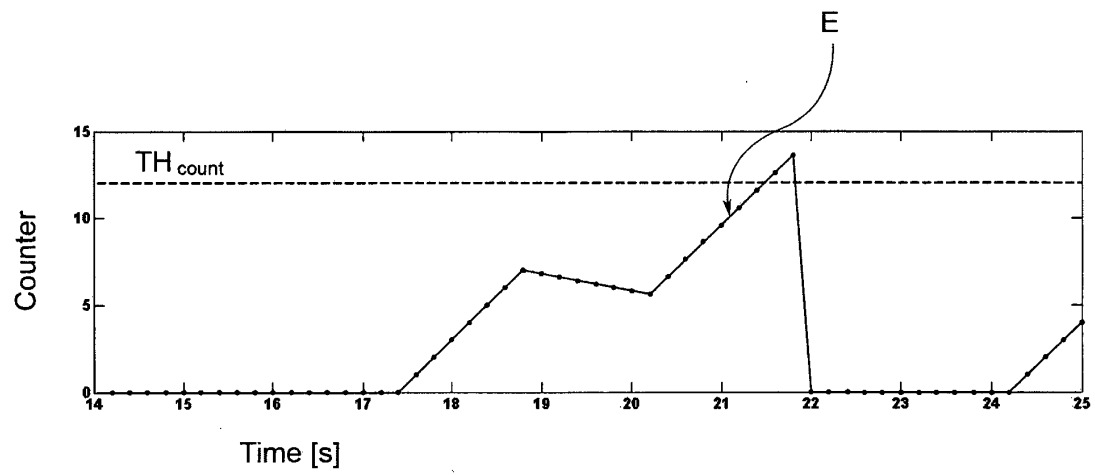


FIG. 5b

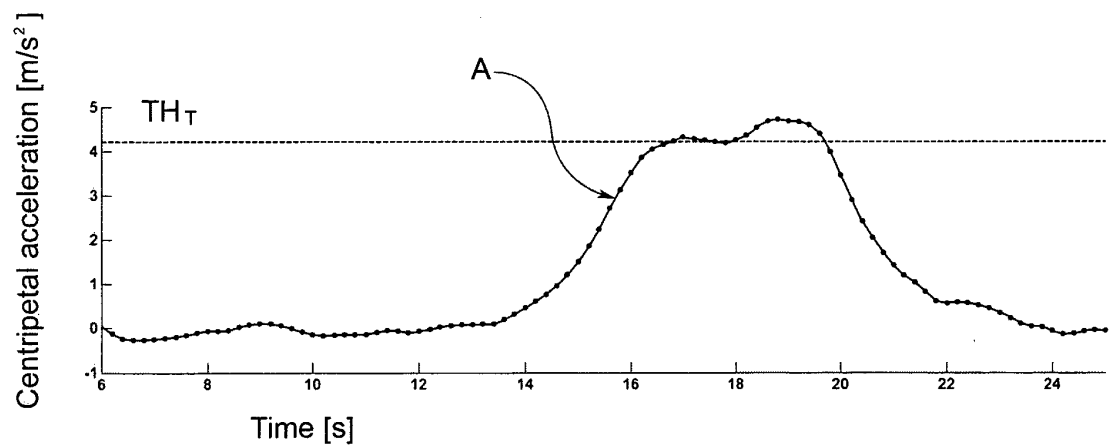


FIG. 6a

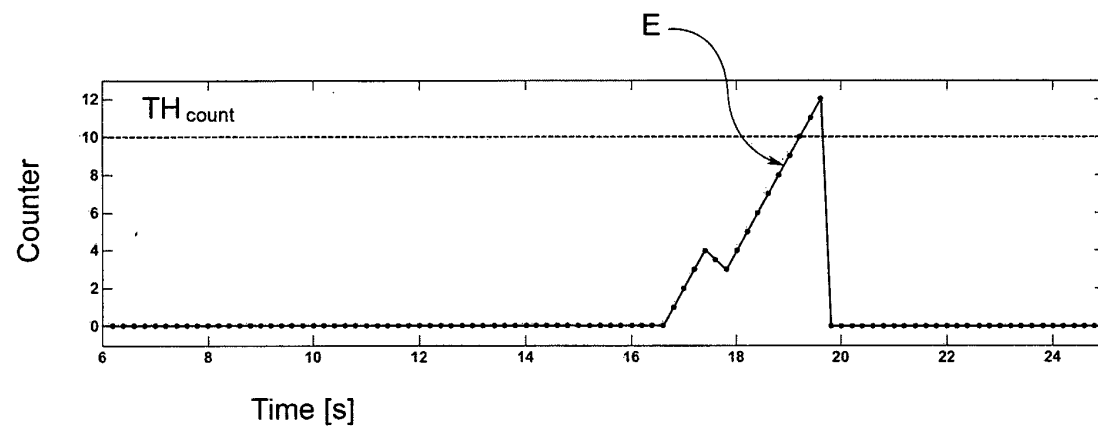


FIG. 6b

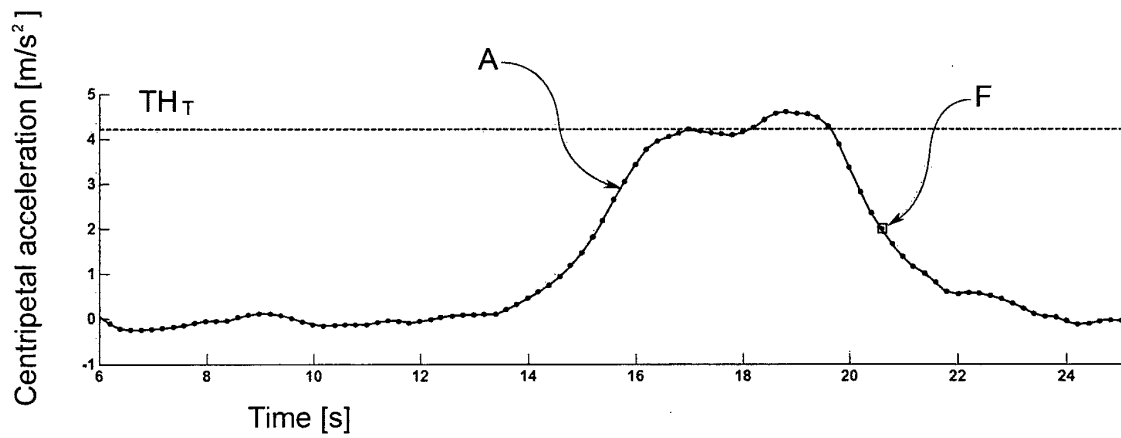


FIG. 7a

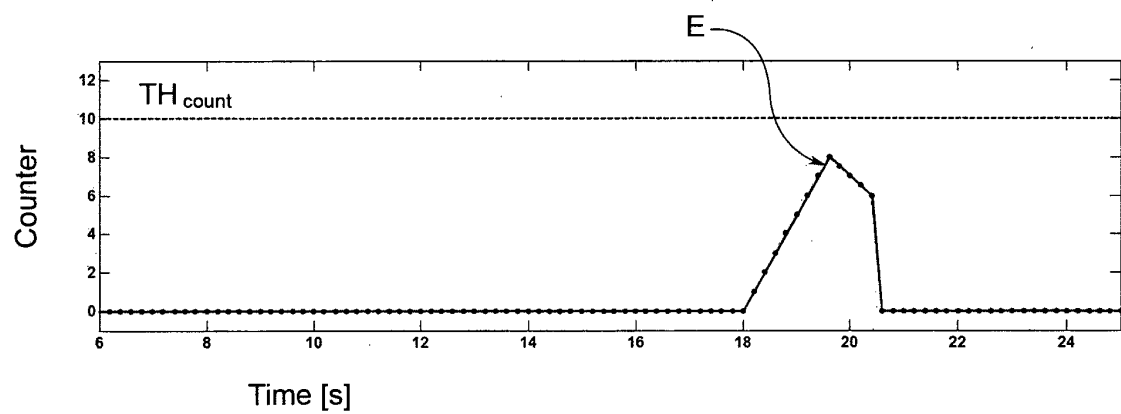


FIG. 7b

REFERENCES CITED IN THE DESCRIPTION

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