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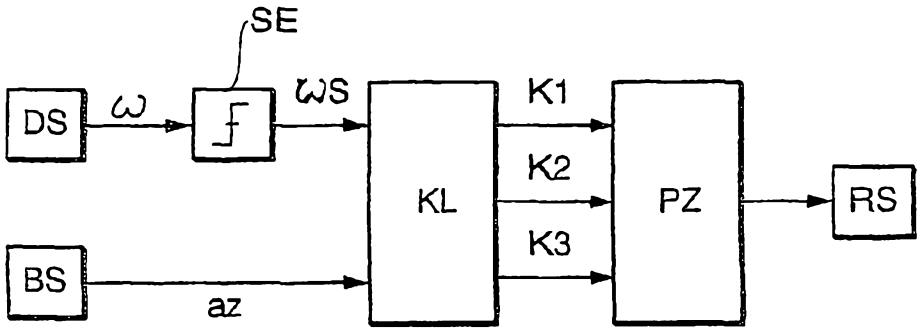
[Fortsetzung auf der nächsten Seite]

(54) Title: DEVICE FOR CLASSIFYING VARIOUS DRIVING MANOEUVRES

(54) Bezeichnung: ANORDNUNG ZUR KLASSIFIKATION VON VERSCHIEDENEN FAHRMANÖVERN



(57) **Abstract:** The invention relates to a device which is able to differentiate between various characteristic driving manoeuvres (K1, K2, K3), whereby a special trigger algorithm can be initiated for each class of driving manoeuvres by means of restraint systems. The inventive device comprises an acceleration sensor (BS) which measures the acceleration (az) of the motor vehicle in the direction of the vertical axis. A classificator (KL) is also provided. When the measured acceleration exceeds a given threshold of 1g, a driving manoeuvre whereby the vehicle is unilaterally lifted, such as when driven over a ramp, is chosen by said classificator. If the accelaration (az) ranges between 0g and 1g, the classificator (KL) opts for a driving manoeuvre (K2) whereby the vehicle is unilaterally tilted in a downward direction, such as when driven over an embankment.

(57) **Zusammenfassung:** Die Anordnung soll zwischen verschiedenen charakteristischen Fahrmanövern (K1, K2, K3) unterscheiden können, so daß für jede Klasse von Fahrmanövern ein spezieller Auslösealgorithmus von Rückhalteeinrichtungen initiiert werden kann. Diese Anordnung weist einen Beschleuningungssensor (BS) auf, der die Beschleunigung (az) des Fahrzeugs in Richtung seiner Hochachse mißt. Es ist ein Klassifikator (KL) vorhanden, der, wenn die gemessene Beschleunigung (az) oberhalb einer Schwelle von 1g liegt, auf ein Fahrmanöver (K1) entscheidet, bei dem das Fahrzeug, wie bei einer Rampenüberfahrt, einseitig nach oben abhebt. Liegt die gemessene Beschleunigung (az) zwischen 0g und 1g, so entscheidet der Klassifikator (KL) auf ein Fahrmanöver (K2), bei dem das Fahrzeug, wie bei einer Fahrt über eine Böschung, einseitig nach unten kippt.

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Zur Erklärung der Zweibuchstaben-Codes, und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

Arrangement for classifying various driving manoeuvres

Prior Art

An arrangement for recognising an imminent rollover of a vehicle is known from DE 197 44 083 A1. In it, dependent on the measured vehicle rollover angle, a critical yaw rate of the vehicle around its centre of mass is determined. As can be learned from this publication, the critical yaw rate corresponds to a kinetic energy of rotation of the vehicle, which just exceeds the potential energy of the vehicle. If this is the case, ie. if the critical yaw rate is reached, then a rollover of the vehicle will result. An early prognosis should be made as to whether, based on a certain driving manoeuvre, a rollover of the vehicle will result, so that safety devices (eg. airbags, rollover bar, etc.) can be actuated. A rollover procedure of a vehicle is very probable in a driving manoeuvre in which, on the one hand the centre of mass of the vehicle in the gravitional field of the earth is increased to a certain extent, for example when driving over a ramp, and on the other the vehicle still has ground contact. In the driving over a ramp of this type the vehicle experiences a change from kinetic energy of rotation to potential energy. Another driving manoeuvre, which will most probably lead to a rollover of the vehicle is inclined driving in which the vehicle drives over an embankment and rolls over. In an embankment roll the result is different from driving over a ramp; potential energy is converted to kinetic energy of rotation. The vehicle rolls without external influences (other than gravity) down the slope. Vehicles in extreme avoidance manoeuvres show similar behaviour as with driving over a ramp (eg. fish hook, elk test) or by lateral drifting with abrupt change of the friction coefficients (curb/soil tripped rollover). These two different types of driving manoeuvres can lead to rollover procedures, which give rise to a fundamentally different movement of the passengers in the vehicle. In order, in all such cases, to

offer optimal protection it is necessary to react to the various types of rollover procedures with correspondingly adapted actuation procedures for restraint devices.

The task of the invention is to provide an arrangement to classify various driving manoeuvres, which can lead to the rollover of a vehicle, an arrangement which distinguishes between various characteristic driving manoeuvres, so that for the driving manoeuvre category decided on by the arrangement, a special actuate algorithm for restraint devices can be initiated.

Advantages of the invention

The named task is undertaken with the characteristics of Claim 1, in that an acceleration sensor is present, which measures the acceleration of the vehicle in the direction of its vertical axis, and that, when the measured acceleration is above a threshold of 1g, a classificator decides on a driving manoeuvre in which the vehicle, as in a ramp drive, lifts on one side and that the classificator, in the case of acceleration of between 0g and 1g decides on a manoeuvre in which the vehicle, when driving over an incline, tilts downwards on one side.

According to the invention, a decision between two main classes of driving manoeuvres is possible, namely in the type of driving over a ramp and driving over an embankment. These two driving manoeuvre categories differ by means of the opposing directions of their barycentre acceleration. When driving over a ramp the barycentre acceleration is directed in a positive direction of the vertical axis of the vehicle and when driving down an embankment in a negative direction of the vertical axis of the vehicle. In both driving manoeuvre categories the occupants experience very different movements, which necessitate varied controlling of restraint devices in the vehicle.

Advantageous further developments of the invention proceed from the subclaims. Then the classificator decides, with a measured acceleration of approximately 0g on a manoeuvre, which corresponds to a free fall.

It is expedient that the classificator carry out a threshold value decision of the measured acceleration for deciding the driving manoeuvre category, when a yaw rate of the vehicle around its longitudinal axis measured by a yaw rate sensor exceeds a given threshold.

Drawing

The invention will be described in further detail on the basis of an embodiment represented in the drawing. Shown are:

Figure 1 a block diagram of an arrangement for classifying various driving manoeuvres and

Figure 2 a classification of the driving manoeuvre categories dependent on the acceleration of the vehicle in the direction of its vertical axis.

Description of an embodiment

As Figure 1 shows, an acceleration sensor BS is present in order to distinguish between three different categories K1, K2 and K3, which measures the acceleration az in the direction of the vertical axis of a vehicle. This is the so-called low g acceleration sensor. The measured acceleration signal az is relayed to a classificator KL. This classificator KL is in principle a threshold value decider.

It is shown in Figure 2 how the classificator KL undertakes the classification in K1, K2 and K3 based on the acceleration az in the direction of the vertical axis of the vehicle. If an acceleration az is measured, which is above a threshold of 1g – g refers to gravitational acceleration – then the classificator KL decides on a driving manoeuvre K1 in which the vehicle lifts on one side. A driving manoeuvre of this type occurs when driving over a ramp or in a lateral drift of the vehicle with an abrupt change of friction coefficients (curb/soil tripped rollover) or in extreme avoidance manoeuvres (eg. fish hook, elk test).

If it is established by the classificator KL by means of a threshold value decision, that the measured acceleration az lies in the direction of the vertical axis of the vehicle between 0g and 1g, it decides on a driving manoeuvre category K2 in which the vehicle tilts downwards on one side as is the case when driving down an embankment.

If an acceleration az in the vicinity of 0g is established by the classificator KL, it decides on a driving manoeuvre category K3, which corresponds to a free fall of the vehicle, which is the case when the vehicle lifts completely from the ground.

In the vicinity of a measured acceleration az of 1g, one can speak of normal driving when the vehicle is moving on a level carriageway without an abrupt lift or tilt.

The classificator KL receives the start signal ωs for the threshold value decision of the measured acceleration az in the direction of the vertical axis of the vehicle. This start signal ωs firstly causes, when the yaw rate ω measured by a yaw rate sensor DS around the longitudinal axis of the vehicle exceeds a certain threshold value ωs determined by a threshold value decider SE, the acceleration az is subjected to a threshold value decider. Because not until the vehicle has a certain yaw rate does it become probable that a rollover can result at all. Not until then is there any point in the classificator KL classifying the current driving behaviour of the vehicle in a driving manoeuvre category K1, K2 or K3, which will lead to a characteristic rollover behaviour.

The driving manoeuvre category K1, K2 or K3 determined by the classificator KL is relayed to a processor PZ. In this processor PZ, dependent on the driving manoeuvre relayed, a certain actuate algorithm for restrain devices (eg. airbags, seat belts, rollover bars, etc.) is initiated. Because in every driving manoeuvre category K1, K2 or K3 and the special rollover behaviour resulting from them, another movement of the occupants results to which a reaction with a special actuation constellation (time and sequence) of restraint devices is made.

Claims

1. Arrangement for classifying various driving manoeuvres, which can lead to the rollover of a vehicle, characterised in that an acceleration sensor (BS) is present, which measures the acceleration (az) of the vehicle in the direction of its vertical axis and that a classificator (KL) decides, when the measured acceleration (az) is above a threshold of 1g (g is gravitational acceleration), on a driving manoeuvre (KL) in which the vehicle, as when driving over a ramp, lifts on one side, and that the classificator (KL) decides, in the case of an acceleration (az) between 0g and 1g, on a driving manoeuvre (K2) in which the vehicle tilts downwards on one side as when driving over an embankment.

2. Arrangement according to Claim 1, characterised in that the classificator (KL) decides with a measured acceleration of approximately 0g, on a driving manoeuvre (K3), which corresponds to a free fall of the vehicle.

3. Arrangement according to Claim 1 or 2, characterised in that the classificator (KL) implements a threshold value decision of the measured acceleration (az) when a yaw rate (ω) of the vehicle around its longitudinal axis measured by a yaw rate sensor (DS) exceeds a given threshold (ωs).

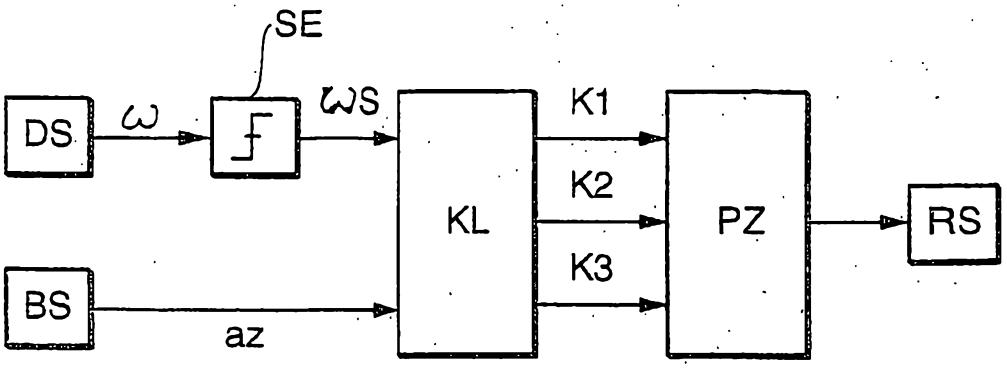

Fig. 1

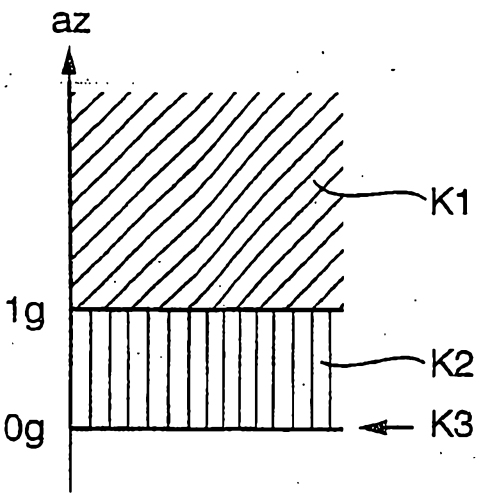

Fig. 2