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(54) Vehicle monitoring system

(57) System designed to detect a passing vehicle at two mutually spaced locations along a track with detection loops in the road surface reacting to a disturbance of the magnetic field caused by said passing vehicle, which loops generate detection signals of a flow of succeeding vehicles, passing the detection means in the same direction, wherein said detection signals are processed for each individual vehicle to determine which of the vehicles in said flow have passed both the first and second detection location.

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Description

[0001] A system is provided designed to detect a vehicle at at least two mutually spaced locations along a track by means sensitive for a disturbance of a magnetic field, such as a detection loop known as such within the road surface, and mutually evaluate data, based on the detection at said two locations. E.g. said evaluation serves to decide of a vehicle detected at the one position is also detected at the other position.

[0002] This invention is based on the novel recognition that an individual vehicle can be recognised by the disturbense of the magnetic field caused by it. Said disturbance can be adopted as an individual "signature". This novel recognition goes further than the excisting recognition, from which it is known that by the disturbance of the magnetic field vehicle types (e.g. Fiat Punto - Opel Corsa) can be differentiated.

[0003] Thus, with detection loops in the road surface a monitoring system for individual vehicles is possible with a high level of privacy, serving as an attractive alternative to the already known vehicle monitoring system based on recorded images.

[0004] Preferably the system is designed such that the detection means generate detection signals of a flow of succeeding vehicles, passing the detection means in the same direction, wherein said detection signals are processed for each individual vehicle to determine which of the vehicles in said flow have passed both the first and second detection location.

[0005] An evaluation result can e.g. be used to control a traffic control device (VRI). Thus the action of the VRI can e.g. be automatically adapted to the traffic density as determined by the detection means. Another application could be checking the driving speed, based on the driving speed over a covered distance.

[0006] It will be appreciated that preferably the detection signals, or data relating thereto, obtained (received) during passage of the first (upstream) detection location are stored (e.g. in a memory means) to process (e.g. compare) them with the detection signals of related data obtained during passage of the next (downstream) detection location.

[0007] Since in practice the detection locations can have a relatively large mutual spacing, it is prefered if the system comprises (possibly wire less) transmission and receiving means to be able to transmit the detection data of relating data to a remote processing unit.

[0008] For a reliable detection and evaluation it is prefered that the detection means are designed such that during passage of a detection location by a vehicle a large number of detections is carried out thereto (sampling). Particularly because of the possibility of a high vehicle passage speed a detection time of 100 ms (milliseconds) at the most, such as 50 ms at the most en particularly 10 ms at the most is prefered. The expected convenient detection time will be in de order of some milliseconds (e.g. 1, 2, 3 or 4 ms; i.e. each e.g. 4 ms a detection of the same vehicle). It will be appreciated that the detection time can be longer the slower the driving speed is, or the detection means extend over a larger distance in the driving direction. However elongated detection means are expensive and vulnerable.

[0009] To be able to take account of important differences of length and driving speed of individual vehicles without the need to claim much (computer) processing capacity, memory or such, it is prefered to use a maximum number of detections (samples) for the evaluation per vehicle and when said number is exceeded to carry out a procedure such that detections spread over at least substantially the complete measuring time range play a role with the evaluation. E.g. in that connection succeeding detections are combined into a combination detection (mean value).

[0010] According to a further development it is prefered that the detection means (e.g. detection loop) of the upstream and downstream location are at least substantially equally constructed, which contributes to a accurate evaluation result. For the same reason it is prefered that the detection means have at least substantially the same sensitivity.

[0011] For an acceptable evaluation it is prefered that the applied detection data or relating data for the different detection locations are evaluated at least substantially at the same parameter scale. It is therefor prefered to provide the system with means to mutually tune the one or more parameter scales of the different detection locations. A possible parameter is the moment in time at which the vehicle passes a detection location (time sclae parameter) or the strength of the detection signal (amplitude scale parameter).

[0012] It is further prefered to provide the system with data compressing means to compress the detection data (or relating data) of the vehicle. Thus the data exchange, data storage en evaluation is simplified. The compressing means are preferably designed such that they are compressed at a scale from 0 to 255.

[0013] For e.g. the evaluation it is prefered that the system is designed to detect/determine/process/evaluate at least one of the following: moment in time of passage of a detection location; max. "verstemming"; relevant detections.

[0014] For the evaltuation the system comprises a processing unit which (directly or indirectly) is connected in a data transferring manner with at least two mutually spaced detection locations to detect passing vehicles. Data originating from said detection locations merge at said processing unit to evaluate.

[0015] For the evaluation the system is preferably designed to use a data of a first vehicle relating to the one detection location in a comparison procedure wherein data is processed of a plurality of vehicles, among which said first vehicle, relating to the other detection location. This is e.g. a "best-fit" procedure, wherein the data set (of the first vehicle) relating to the one detection location is set by set compared with the data sets (of a plurality

of vehicles) relating to the other detection location, until from said plurality the (according to the applied predetermined criteria) most corresponding set is traced, on the basis of which the system can then decide at which moment in time the vehicle belonging to said corresponding sets has passed both said detection locations.

[0016] Further, an embodiment is discussed. It will be appreciated that the invention is not limited to this embodiment. Also other embodimenst based on this disclosure belong to the invention.

[0017] A driving lane in an urban area has in the road surface, viewed in the same driving direction, at 100 m in front of and 25 m beyond, respectively, a road crossing an identical right angled detection loop (first and second, resp.) with a width of 1 m and a length of 3 m. Both detection loops are connected to a power supply unit and a detection unit through burried leads. At the road crossing traffic lamps are provided which are switched by a traffic control system (VRI) belonging to the system.

[0018] The power supply supplies galvanic AC to the detection loops, which therewith generate an electromagnetic field. Metal parts of vehicles moving through said magnetic field disturb said field. These disturbances are detected by the detection unit, which therefor samples the detection loops each 3 ms and determines for each sampling a sample value. If there is no vehicle at the road surface above the detection loop, the sample value corresponds to the undisturbed magnetic field as generated by the detection loop, such that the system assumes said sample value as treshold value. Depending on the vehicle (e.g. dimension, bottom clearance, weight, etc.) the sample value will differ from the treshold value.

[0019] As soon as the system finds a sample value different from the treshold value, the system opens a record in the computer memory in which all samples in the detected succession are stored until the firstcoming next sample with the treshold value. This record is the characteristic of a vehicle and also contains further data, among which the moment in time at which it is made. Tf the number of samples exceeds a predetermined number (e.g. in case of a long, slow vehicle), a sample is assembled from successive detected samples (mean value) an added to the record, such that the dimension of the record is limited.

[0020] The system comprises a filter step, with which noise, etc. is removed from the detection as much as possible. The system also conprises a compression step, with which the record is compressed while maintaining the characteristic.

[0021] Thus the system makes the record for all vehicles that successively pass the first detection loop. As soon as a record is made for a vehicle that has passed the second detection loop, the system compares said record with the earlier made (and stored in its memory) record belonging to the first detection loop. As soon as a corresponding record is traced the comparison is ended and the file is updated which is used to command the traffic control system (VRI).

Claims

1. System designed to recognise an individual vehicle or vehicle type by its disturbance of a (electro) magnetic field generated by said system.

2. System according to claim 1, designed to detect a vehicle at at least two mutually spaced locations along a track with means reacting to a disturbance of the magnetic field, such as a detection loop in a road surface known as such, and using data, based on said detection at said two locations, in an evaluation.

3. System according to claim 1 or 2, wherein it is designed such that the detection means generate detection signals of a flow of succeeding vehicles, passing the detection means in the same direction, wherein said detection signals are processed for each individual vehicle to determine which of the vehicles in said flow have passed both the first and second detection location.

4. System according to any of the preceeding claims, coupled with and providing signals to comtrol a traffic control device (VRI) or similar automatic device used by the road manager for traffic control, such as a photo camera for speed control.

5. System according to any of the preceeding claims with memory means to store detecting signals or relating data; and/or transmission and/or receiving means to transmit the detection data or relating data to a remote processing unit.

6. System according to any of the preceeding claims, designed such that during passage of a detection location by a vehicle a plurality of detections (sampling) is carried out thereon and/or a detection time of 100 ms (millisecond), such as 50 ms at the most, particularly 10 ms at the most is applied.

7. System according to any of the preceeding claims designed to aplly a maximum number of detection (samples) for each vehicle and when exceeding said number to carry out a procedure such that detections across at least substantially the complete measuring time range play a role with the evaluation, e.g. by determining the mean of two or more successive detections.

8. System according to any of the preceeding claims, woth at least one of the following:

   - the detection means of the upstream and down-

stream location are at least substantially equal constructed and/or have at least substantially the same sensitivity;

- means to mutually tune one or more parameter scales of different detection locations;
- data compressing means to compress the detection or relating data of a vehicle, preferably at a scale of 0 to 255;
- means to detect/determine/process/evaluate at least one of the following: moment in time of passage of a detection location; max. "verstemming"; relevant detections.

9. System according to any of the preceeding claims, designed to use data of a first vehicle relating to the one detection location in a comparison procedure wherein data is processed of a plurality of vehicles, among which said first vehicle, relating to another detection location.

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EUROPEAN SEARCH REPORT

Application Number
EP 03 07 7149

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Y		2	
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A	US 5 331 276 A (POLVANI DONALD G ET AL) 19 July 1994 (1994-07-19)		TECHNICAL FIELDS SEARCHED (Int.Cl.7) G08G

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24 October 2003	Créchet, P

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 07 7149

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
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82