

ENHANCING THE PERFORMANCE OF ELECTRONIC DEVICES

The present invention relates to a method for enhancing the performance of electronic equipment and associated electronic equipment having increased performance.

5 The invention is in the field of improving the performance of electronic equipment, in particular for communications, identification, and navigation equipment, that is usable in systems on board moving carriers, or for communicating with such carriers.

 The invention finds particular applications in the fields of control and piloting of aircraft for example, or more generally in situation analysis systems on board mobile
10 platforms such as ships, submarines, fighting planes, helicopters, surveillance planes, armored vehicles ...

 The electronic equipment in question is, in particular, radio communications equipment (transmitters, receivers and transmitters/receivers), radio navigation (for example radio altimeters), identification, electronic warfare and radars. These devices are also
15 classically called sensors in the literature.

 In a known manner, the equipment of the aforementioned type is equipped with basic self-test functions, which provide an authorization for use or a defense against use ("GO" or "NO GO" states) as output, without providing further information. The use of such self-test functions ensures a certain level of security by prohibiting the use of equipment that
20 presents a malfunction, without generally, however, allowing an operator of the system using the equipment to know the reasons for the malfunction detected, and without storing the associated details. As a result, this type of method does not improve the performance of equipment or the control of the system that uses the equipment.

 It is also known to perform predictive maintenance for equipment of the
25 aforementioned type. To do this, operating data are collected, in connection with, for example, the duration of use, the temperature differences during use or the amount of vibration of the carrier. This then makes it possible to calculate operating statistics and probabilities of failure. Predictive maintenance then consists in replacing equipment according to these probabilities of failure, before equipment failure occurs. This type of
30 maintenance is particularly suitable for mechanical components, for which the constraints of use induce foreseeable wear. However, it has been observed that this type of maintenance is less suitable for electronic components, which may exhibit random malfunctions.

The object of the invention is to remedy the drawbacks of the prior art by proposing electronic equipment of the aforementioned type having increased capacities.

To this end, the invention proposes, according to a first aspect, electronic equipment having increased performance and comprising at least one calculation processor and at least one memory unit. This equipment stores a map of operating levels as a function of at least one parameter that is representative of a condition of use of said equipment, comprising a nominal operating level and at least one degraded or improved operating level. In addition, it is configured to:

- receive at least one parameter value that is representative of a condition for using said equipment,
- determine, from said stored map, an operating level associated with said parameter value, and
- issue an alert if the determined operating level is a degraded operating level.

Advantageously, the operation of this increased electronic equipment is based on the storage and use of a map of operating levels as a function of at least one parameter representative of a condition of use of said equipment, which makes it possible to alert an operator of the equipment of malfunctions related to specific conditions of use, in order to adapt the use for optimized operation.

The equipment according to the invention may have one or more of the characteristics below, taken independently or in combination, according to all technically feasible combinations.

The parameter is representative of geolocation information and/or time stamping information and/or of a temperature of use and/or of a weather condition in an environment of said equipment and/or of a duration of operation of said equipment and/or of a radio-electric environment.

The equipment is suitable for, if the determined operating level is an improved operating level, transmitting information indicating at least one adjustment parameter making it possible to operate said equipment at an operating level lower than said improved operating level.

The equipment is configured to obtain a set of adjustment parameters associated with the determined operating level, and to dynamically apply said set of adjustment parameters to said equipment.

The memorized map is obtained by processing data obtained from a plurality of devices of the same family of devices.

The equipment is suitable for transmitting securely to a calculation system an operation/malfunction log comprising time-stamped operating data of said equipment, as well
5 as data collected from sensors associated with said equipment.

According to a second aspect, the invention relates to a method for increasing the performance of electronic equipment comprising at least one calculation processor and at least one electronic memory, suitable for being carried on board a carrier. This method includes a prior step of memorizing a map of operating levels as a function of at least one
10 parameter that is representative of a condition of use of said equipment, comprising a nominal operating level and at least one degraded or improved operating level, along with steps, executed by a processor of said equipment and designed to:

- receive at least one parameter value that is representative of a condition for using said equipment,
- 15 - determine, from said stored map, an operating level associated with said parameter value,
- issue an alert if the determined operating level is a degraded operating level.

The method of increasing the performance of electronic equipment according to the invention may have one or more of the characteristics below, taken independently or in
20 combination, according to all technically feasible combinations.

The method comprises, if the determined operating level is an improved operating level, the transmission of information indicating at least one adjustment parameter making it possible to operate said equipment at an operating level lower than said improved operating level.

25 It also comprises a step consisting in obtaining and applying a set of parameters for adjusting said equipment associated with the determined operating level.

Several parameters representative of conditions of use define said map, and the receiving step comprises receiving predicted position information relative to a planned route and an estimated value of a parameter that is representative of a condition of use associated
30 with said route planned for said equipment, and following the emission of an alert, a route modification is carried out so as to avoid a route crossing an area of said map corresponding to a degraded level of operation.

The method includes a step of receiving a map of operating levels obtained by a calculation system designed to process massive data.

When said equipment belongs to a family of equipment, the map is obtained in a prior step, by analysis and processing of data comprising operation/malfunction data and data
5 from sensors collected by at least one piece of the equipment of said family of equipment.

The data used in the analysis and processing step further includes additional environmental data including meteorological and/or geographic data and/or radio environment data.

10 Other characteristics and advantages of the invention will emerge from the description which is given below, for information and in no way limitative, with reference to the appended figures, among which:

- Figure 1 is a diagram of a control and management system according to an embodiment of the invention,
- 15 - Figure 2 is a flow diagram of the main steps of a method of collecting operating data in one embodiment;
- Figure 3 is a flow diagram of the main steps of a method for generating a map of operating levels according to one embodiment;
- Figure 4 is a schematic representation of an example of a map of the operating
20 levels;
- Figure 5 is a flow diagram of the main steps of a method for increasing the performance of a piece of equipment according to one embodiment.

Figure 1 schematically illustrates an on-board control and management system 2,
25 designed to communicate by means of wired or wireless communication with a calculation system 4.

In one application scenario, the control and piloting system 2 is on board a carrier, for example an aircraft (not shown), while the calculation system 4 is located in a centralized processing station located on a platform, for example on the ground.

30 In the embodiment shown, the control and management system 2 includes electronic equipment 6 having increased performance.

Of course, a control and management system 2 may comprise a plurality of such equipment.

In the example shown, the equipment 6 is a piece of electronic equipment comprising a functional module 8, comprising at least one sensor, designed to achieve a given functionality of said equipment 6. In one embodiment, the functional module 8 has a capacity for its own calculation and communication, for example a processor or an electronic card.

In an example of an application, the module 8 is a radio altimeter comprising a transmitter/receiver of radio-electric signals, making it possible to measure the distance of the equipment 6 relative to a surface overflown. In the prior art, different types of radio altimeters are known, the general principle of such equipment being to measure the height relative to the surface overflown by measuring the propagation time of radio-electric signals transmitted and received after reflection from this surface.

In another example of application, the module 8 is a radio communications transmitter/receiver, making it possible to establish a radio link with one or more other carriers. In the prior art, we know of different equipment but also waveforms (set of processes making it possible to transmit data by a radio wave), the general principle of such equipment being to modulate a signal so as to transmit it in the form of a radio wave, according to a protocol and with protections (corrective coding, frequency evasion, encryption, etc.) defined between the various communication players.

The invention applies more generally to other types of electronic equipment, not comprising a radio signal transmitter/receiver.

In addition, the equipment 6 comprises a communication interface 10 with a plurality of sensors 12a, 12b, 12c, 12d, 12e which are also part of the system 2 and are designed to transmit information to the equipment 6 via the interface 10.

For example, the communication interface 10 is a wired connection interface. Alternatively, it is a wireless communication interface. This interface may be plural with certain sensors being connected by wireless, while others are wired according to their capacities.

In one embodiment, the sensor 12a is a geolocation sensor implementing a geolocation system by GNSS satellite (Global Navigation Satellite System), designed to estimate, at regular time intervals, geolocation information in a given spatial reference system. The geolocation information includes, for example, spatial position information, for example coordinates in a 3D repository, and temporal information (date, time), also called time stamping information.

The sensor 12b is, for example, a temperature sensor, designed to supply a measurement value of the temperature near the equipment 6.

The sensor 12c is, for example, a hygrometry sensor, designed to provide a humidity rate value near the equipment 6, while the sensor 12d is, for example, an
5 accelerometer.

The sensor 12e is, for example, a spectrum analyzer, making it possible to discover the local radio environment in a band of interest for the system.

Of course, Figure 1 is an example, wherein a higher or lower number of sensors may be used.

10 In an alternative embodiment, the sensors are integrated into the equipment 6. Typically, a simple spectrum analysis function may be performed by the reception function of the radio equipment (when it is not used elsewhere, or sometimes in addition thanks to parallel processing).

15 In addition to the sensors 12a to 12e, the equipment 6 is able to self-capture internal operating information (e.g. atypical heights, propagation conditions, etc.) from the functional module 8 or calculation processor 14 or from label circulating on internal buses.

The equipment 6 also comprises a calculation processor 14, a memory unit 16, a communication unit 18 as well as a cryptographic module 17 for securing the information stored in the memory and its transmission.

20 As a variant, these units may be produced in the form of programmable logic components, such as an FPGA (Field-Programmable Gate Array), or also in the form of dedicated integrated circuits, of the ASIC type (Application- Specific Integrated Circuit).

25 The communication unit is designed to communicate with the calculation system 4 according to an adapted communication protocol.

In one embodiment, the communication unit 18 is a wireless communication unit.

As a variant, the communication unit 18 is a wired communication unit, for example making it possible to implement an Ethernet connection.

30 The communication link produced by the communication unit 18 is, for example, encrypted to achieve secure communication.

The memory unit 16 is designed to store, in particular, an operation/malfunction log 21, comprising, in particular, a report of malfunctions or breakdowns, enriched with information transmitted by the sensors 12a to 12e, as well as a map 20 of operating levels as

a function of at least one parameter that is representative of a condition of use of the equipment.

The map 20 is the main element allowing the increased operation of the equipment. It is built using feedback from the operation of the equipment and then, preferably, loaded
5 (and updated) into all the equipment of the same family.

The generation and use of such a map 20 will be detailed below.

The memory unit 16 also stores several sets 22 of adjustment parameters for controlling the operation of the functional module 8.

The equipment 6 is also suitable for communicating, for example using a wired
10 connection 23, with an on-board computer 24, which is schematically represented in Figure 1.

Such an on-board computer comprises, in particular, a man-machine interface 26, making it possible to communicate with an operator, in particular to enable him to control the functionalities implemented by the on-board equipment 6 as well as to configure the associated sensors 12a to 12e.

15 The on-board computer includes an electronic computer 28 and a communication unit 30, designed to communicate with the calculation system 4.

In one embodiment, it is the on-board computer which centralizes and manages all communications with the calculation system 4, via the communication unit 30. In this case, the equipment 6 transmits all of the information to be communicated, in particular the
20 operation/malfunction log 21, for example by a secure communication link, to the on-board computer 24.

Like the communication unit 18, the communication unit 30 is a wireless communication unit in one embodiment. As a variant, the communication unit 30 is a wired communication unit, for example making it possible to implement an Ethernet connection.
25 Preferably, the communication performed by the communication unit 30 is secure. For example, all the information communicated is encrypted by the cryptographic module 17.

The calculation system 4, which is, for example, located in a centralized processing station comprises, in particular, one or more calculation servers 40 and one or more memory units 42, designed to store large quantities of digital data.

30 The calculation system 4 also comprises a communication unit 44, designed to implement the communication protocol used respectively by the units 18 or 30.

Figure 2 is a flow diagram of a method for collecting operating data used for generating a map of operating levels, in one embodiment.

As explained in detail below, steps 50 to 58 are implemented by electronic equipment 6, while step 60 is implemented by a calculating system 4.

This method is implemented during a preliminary phase of testing the equipment, but may also be implemented during a phase of operational use of the equipment, making it possible to enrich the map of the operating levels.

The method comprises a first step 50 of acquiring data relating to the operation of the equipment 6. This data comprises, on the one hand, time-stamped data relating to the operation of the module 8 of the equipment 6, including breakdowns or failures, supplied, for example, by the self-test system of the equipment 6, and, on the other hand, data received from the sensors 12a to 12e. The operating data are, for example, altitude measurements in the case of a radio altimeter, taken at regular time intervals, or also the flow rates or ranges obtained in the case of radio communication equipment, or also local interference levels or types of propagation channels encountered.

In one embodiment, the sensor data includes at least one piece of location information, for example geographic and/or temporal.

The data collected is gathered in step 52 in an equipment operation/malfunction log 6. Any malfunctions or failures are recorded, for example the results of the self-test system implemented by the equipment. The operation/malfunction log also includes time information, for example the date and time associated with the operating data, as well as data from the sensors 12a to 12e which may be correlated with the operating data.

Then, in step 54, it is checked whether the communication resources are available for the transmission of operating data. In fact, it is possible that the communication resources are used for more priority tasks, for example tasks relating to determining when the method is to be implemented on board an aircraft.

In the event of a negative response to the verification step 54, this step is followed by a step 56 for storing the operation/malfunction log for later use.

In the event of a positive response to step 54, this is followed by a step 58 of transmitting the operating log(s) containing the data collected by the equipment 6, to a calculation system 4.

According to one embodiment, the transmission is carried out by radio communication, using suitable communication units.

Alternatively, the transmission may be made by a wired connection. In this case, the transmission is made after the acquisition of the data, the equipment in this case being directly connected by a wired link to the calculation system 4.

5 The calculation system receives the operation/malfunction log(s), and stores them in step 60.

Steps 50 to 60 are repeated throughout the operation of the equipment 6.

The calculation system 4 is designed to receive data collected by the same equipment over several time periods, as well as data collected by several pieces of equipment of the same family of equipment.

10 A family of equipment is a set of pieces of equipment having the same technical specifications and comprising similar components, for example equipment of the same range supplied by a manufacturer.

Figure 3 is a flow diagram of a method for analyzing data relating to the operation of the equipment and collected to generate a map of operating levels, in one embodiment.

15 The steps of this method are implemented by a calculation system 4, having extended calculation capacities, including, if necessary, for processing massive data.

In fact, the memory units 42 of a calculation system 4 store very large amounts of collected data, from the same equipment 6 or from a plurality of pieces of equipment from the same family of equipment.

20 The data analysis method optionally includes a step 70 for receiving and storing additional data.

The additional data comprises, in one embodiment, environmental data, for example localized meteorological data. Thus, it is possible to correlate the operating data in question with meteorological conditions, knowing the date, the time, and the spatial location
25 information associated with the stored operating data.

Additional environmental data comprises, for example, geographic data, such as terrain data. Finally, it may comprise radio propagation data obtained by calculation or external measurements.

30 These meteorological and geographic data are, for example, useful for characterizing the operation of a radio altimeter. The propagation data are, for example, useful for characterizing the operation of a transmitter/receiver.

In fact, a radio altimeter may present significant variations in measurements when the terrain is very steep or in the presence of fairly reflective elements (near certain airports

for example). Compared to a surface not over ground, a radio altimeter may exhibit an inaccuracy of measurement when the meteorological conditions are very unfavorable (the antenna performances being degraded).

Thus, equipment may present a local malfunction due to environmental conditions without presenting a failure of one of its components. Similarly, in the case of radio communication, the presence of an obstacle, a very good reflector or even that of a jammer, may lead to a local malfunction without this corresponding to the failure of the equipment. or one of its components.

The aim of a map of operating states is to identify the passage in known areas of ambiguity between a malfunction linked to the environment or a malfunction linked to the equipment.

The additional data may also include technical documentation, industrial data on the reliability of the components of equipment.

Step 70 is followed by a step 72 of processing and analyzing the stored data, including the collected data and, where appropriate, the additional data, to build a map of the operating state of the equipment.

Data analysis is carried out using massive data analysis algorithms (data analytics). For example, to build a map of operating levels, all the instants of malfunction are positioned on a map (using the self-test results relative to the mapped position) or on a calendar (self-test results relative to a time stamp). This makes it possible to identify the map of areas or time instants where the performance of the equipment will not be nominal. Other conditions, such as weather, are correlated with the map of time areas or times. The system in this case will make it possible to identify non-functioning linked to a problem of the equipment or one of its components or an external problem. In one embodiment, the system provides advance information of the duration/area where the operation will be disrupted (or at least context information allowing an operator to estimate this duration/area).

The processing and analysis of the data in step 72 makes it possible to determine in step 74 a plurality of K operating levels, comprising at least one nominal operating level and a degraded operating level compared to the nominal operating level. . In addition, it is also envisaged that the operating levels include one or more operating levels optimized with respect to the nominal operating level.

The nominal level is a level at which the equipment provides satisfactory results, for example exhibiting measurement accuracy with a first predetermined error rate.

A degraded level corresponds to a measurement accuracy having a second error rate higher than the first predetermined error rate.

An improved level corresponds to a measurement accuracy having a third error rate lower than the first predetermined error rate.

5 By way of nonlimiting example, we consider $K = 3$ operating levels, for example a first level N_1 of nominal operation, a second level N_2 at which the measurement accuracy of the equipment is degraded as explained above, and a third level of very severely degraded operation N_3 .

10 A map of operating levels as a function of several parameters representative of conditions of use is generated in step 76.

The map distinguishes areas, according to their location in the space of the parameters representative of conditions of use, each area having an associated operating level for a given set of conditions of use.

In one embodiment, the areas are positioned according to their geographic location.

15 However, it should be noted that the operating areas defined in the map are not necessarily geographical areas, but areas defined as a function of the values or ranges of values of the parameter(s) representative of a chosen condition of use (e.g. temporal...). The areas may also vary with the wider environment (weather, radio environment, etc.).

20 The generated map is then used (step 78) to improve the performance of the equipment of the family of equipment in question, by reinjection into the equipment.

As a schematic example, a map 80 of operating levels is illustrated in Figure 4.

25 The map 80 corresponds to a given area, for example geographic, and includes a division into geographic areas, each point P of a represented area having spatial coordinates in a geolocation reference frame. The map represented diagrammatically in Figure 4 is two-dimensional, but as a variant the points may be represented in a three-dimensional or higher-order frame of reference.

30 Each area represented Z_1, Z_2, Z_3 has an associated operating level, for example level N_1 for the area Z_1 , level N_2 for the area Z_2 , and level N_3 for the area Z_3 , when the parameters defining the predetermined conditions of use take the respective values C_1, C_2, C_3, C_4 .

If the conditions of use change, the division into areas may be modified.

For example, the geographic area considered is in a grid of elementary blocks 82, and for each block, an associated operating level is stored as a function of the values of each condition of use.

5 The size of an elementary block is variable and is chosen as a function, for example, of the functionalities of the equipment and of the type of parameters representative of environmental conditions.

For example, when the condition of use is "temperature", the operating levels as a function of temperature ranges are distinguished.

10 Likewise, when the condition of use is meteorological, a distinction is made, for example, between operating levels depending on conditions such as rain of different intensities, snow, or dry weather.

An operating level determination function makes it possible to calculate an operating level for each elementary block from several parameter values associated with the conditions of use.

15 For example, the operating level determination function selects the most degraded operating level among the operating levels associated with the respective values C_1 , C_2 , C_3 , C_4 for a given block 82.

Multiple uses of such a map are possible.

20 For example, the map may be used to plan a route requiring the use of given equipment. In fact, if it is found that the level of operation of the equipment is degraded in a given geographic area, a route avoiding the geographic area concerned may be provided.

In general, at any time, an event may be compared with the content of the map, in order to anticipate the taking into account of this event.

25 For example, the map makes it possible to alert an operator in real time of the current and future operating levels of equipment, as well as of the causes of the operating level, nominal, degraded or improved, of the equipment, to allow adequate decision-making.

30 In one embodiment, step 78 consists in transmitting the map of operating levels to the equipment 6, using the wireless communication protocol making it possible to communicate between the calculation system 4 and the equipment 6. This aims to allow even more efficient operation of the equipment 6.

As a variant, the transmission of the map of operating levels is carried out via a wired link during a maintenance phase.

Figure 5 is a flow diagram of a method for increasing the performance of an equipment in one embodiment.

This process is implemented by the equipment 6.

As a variant, the method is implemented by an on-board computer of a control and
5 management system on board the carrier carrying the equipment.

During a first step 90, the equipment receives and stores the map of the operating levels previously calculated by a calculation system, either specifically for this equipment, or for the family of equipment.

Step 90 is followed by a step 92 for obtaining sets of parameters for adjusting the
10 equipment for each operating level.

A set of adjustment parameters associated with a given operating level is a set of parameters defining equipment settings which are chosen to maximize the operating capacity of the equipment with respect to the given operating level.

In one embodiment, the sets of adjustment parameters are transmitted at the same
15 time as the map of the operating levels.

As a variant, the sets of adjustment parameters are calculated by the equipment, or stored in the equipment beforehand, for example during manufacture.

Step 92 is followed by a step 94 for recovering values of parameters representative of conditions of use, then making it possible to use the map of operating levels previously
20 recorded.

For example, while the carrier is moving, these are geolocation, temperature and hygrometry parameters provided by the sensors 12a to 12e installed on board the carrier.

In addition, other parameters such as environmental parameters (e.g. meteorological or geographic) are provided.

25 The values of the parameters obtained define the current conditions of use.

The map of the operating levels, previously received and stored, is then used in step 96 to determine the level of operation of the equipment, according to the conditions of use. When a geolocation parameter was used to build the map, the geographic position information for the use of the equipment is also used.

30 When the carrier is on the move, the operating level determined is the current level.

It is then checked in step 98 if the current operating level is the nominal level.

If the operating level is nominal, step 98 is followed by a step 102 described below.

If the level is a degraded level, step 98 is followed by a step 100 consisting in issuing an alert, preferably accompanied by a report detailing the conditions of use and the level of operation.

5 The alert may be sent on a man-machine interface of the equipment, or transmitted to the on-board control and management system for operation. Typically, the alert is intended for an operator for decision-making. This raising of the alert may be a complement for the operator or the system providing them with this increased information, in addition to the usual information possibly meeting operational safety requirements. In this case, it is up to the operator or the system to decide on behavior in the face of these potentially inconsistent
10 feedbacks.

The control and management system transmits the alert to the operator or performs a preventive action, for example the triggering of other equipment, a modification of the powers transmitted, or a modification of the route.

15 Thus, a degraded operating level is taken into account dynamically in real time to improve control and management.

Likewise, it is possible to display an alert of a temporary malfunction in a given area, and to inform the operator of the reasons for such temporary malfunction. For example, the temporary malfunction may be localized spatially or due to a weather disturbance, without failure of a physical component of the equipment. In this case, the operator has clear
20 information and, in certain operational situations, may ignore the alert. Advantageously, the equipment may be re-used after leaving a degraded operating area.

If the determined operating level is an improved level (higher than the necessary quality as estimated either by definition or by operator action), information intended for the operator is displayed in step 100. Preferably, the information includes one or more
25 adjustment parameters making it possible to operate the equipment with a less efficient operating level, in order to save. if necessary, its electrical consumption, its usage time, or other resources used by the equipment. This is particularly advantageous for portable equipment using a battery.

30 Step 100 is followed by a step 102 for updating, if necessary, the parameters for adjusting the equipment as a function of the determined operating level, whether it is a degraded operating level, or nominal operating level.

Thus, if several sets of adjustment parameters are available, the use of a map makes it possible to apply the most appropriate adjustment parameters as a function of the

operating level, so as to optimize the operating performance of the equipment, and saving resources as well. As a variant, the choice to apply other adjustment parameters is left to the operator, after having provided him with the operating level information.

Step 102 is followed by step 94 previously described with parameter values
5 representative of the conditions of use.

As a variant or in addition, in step 98, the determined operating level is compared to the operating state indicated by the self-test of the equipment. This advantageously allows the operator to manage any alert raised by the self-test thanks to the additional information relating to the conditions of use, and to ignore, if necessary, a temporary alert.

10 It should be noted that the method described above also applies to a dynamic modification of the route by a control and management system during the movement of the carrier.

In fact, the conditions of use, in particular the environmental conditions, on a previously planned route, may be anticipated, for example by weather forecasts when this
15 environmental condition affects the level of operation of the equipment.

It is then possible to estimate, from the map of the stored operating levels, the operating levels planned for a later portion of the route, as a function of predicted environmental conditions, and to modify the route if this is possible, so as to avoid areas of degraded equipment operating level, or to search for areas of higher operating level.

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CLAIMS

1.- Electronic equipment having increased performance, said electronic equipment being adapted for communications, identification, and navigation and usable in systems on board moving carriers, or for communicating with such carriers, said electronic equipment comprising at least one calculation processor (14) and at least one memory unit (16), characterized in that it stores in said at least one memory unit (16) a map (20, 80) of operating levels of said electronic equipment, the map being determined in function of at least one parameter representative of a condition for using said equipment, the map comprising areas representative of operating levels in a space of parameters representative of conditions of use of said electronic equipment, the operating levels comprising a nominal operating level and at least one degraded or improved operating level, and in that it is configured to:

- receive at least one parameter value representative of a condition for using said electronic equipment,
- determine an operating level associated with said parameter value, from said stored map (20, 80) and from the received at least one parameter value representative of a condition for using said electronic equipment,
- issue an alert if the determined operating level is a degraded operating level.

2.- Equipment according to claim 1, wherein said parameter is representative of geolocation information and/or time stamping information and/or of a temperature of use and/or of a meteorological condition in an environment of said equipment and/or an operating time of said equipment and/or a radio-electric environment.

3.- Equipment according to any one of claims 1 or 2, designed to send, if the determined operating level is an improved operating level, information indicating at least one adjustment parameter making it possible to operate said equipment at an operating level below said improved operating level.

4.- Equipment according to any one of claims 1 to 3, designed to obtain a set of adjustment parameters (22) of said equipment associated with the determined operating level, and to dynamically apply said set of adjustment parameters (22) to said equipment.

5.- Equipment according to any one of claims 1 to 4, wherein said stored map (20, 80) is obtained by processing data (21) obtained from a plurality of pieces of equipment of the same family of equipment.

5 6.- Equipment according to any one of claims 1 to 5, designed to securely transmit to a calculation system (4) an operating/malfunction log (21) comprising time-stamped operating data of said equipment, and collected data from sensors (12a-12e) associated with said equipment.

10 7.- Method for increasing the performance of electronic equipment said electronic equipment being adapted for communications, identification, and navigation and usable in systems on board moving carriers, or for communicating such carriers, said electronic equipment comprising at least one calculation processor and at least one electronic memory, suitable for being carried on a carrier, characterized in that it includes
15 a prior memorization step (90) of memorizing in said at least one memory unit a map (20, 80) of operating levels of said electronic equipment, the map being determined as a function of at least one parameter representative of a condition of use of said equipment, the map comprising areas representative of operating levels in a space of parameters representative of conditions of use of said electronic equipment, the operating levels
20 comprising a nominal operating level and at least one degraded or improved operating level, and steps, executed by a processor of said equipment to:

- receive (94) at least one parameter value representative of a condition of use of said electronic equipment,
- determine (96) an operating level associated with said parameter value, from
25 said stored map (20, 80) and from the received at least one parameter value representative of a condition for using said electronic equipment,
- issue (100) an alert if the determined operating level is a degraded operating level.

30 8.- Method according to claim 7, comprising, if the determined operating level is an improved operating level, the transmission (100) of information indicating at least one adjustment parameter making it possible to operate said equipment at an operating level below said improved operating level.

9.- Method according to one of claims 7 or 8, further comprising a step of obtaining and applying (102) a set of adjustment parameters (22) of said equipment associated with the determined operating level.

5 10.- Method according to one of claims 7 to 9 wherein several parameters representative of conditions of use define said map (20, 80), and wherein the receiving step comprises receiving predicted position information relative to a planned route and an estimated parameter value representative of a condition of use associated with said planned route for said equipment, and following the emission of an alert, a route
10 modification is carried out, so as to avoid a route crossing an area of said map corresponding to a degraded operating level.

 11.- Method according to one of claims 7 to 10, comprising a step of receiving
15 (90) a map of operating levels obtained by a calculation system designed to process big data.

 12.- Method according to one of claims 7 to 11, wherein said equipment belongs to a family of equipment, wherein said map (20, 80) is obtained (76) in a prior step, by analysis and processing (72, 74) of data comprising operation/malfunction data (21) and
20 data from sensors collected (50, 52) by at least one piece of equipment from said family of items of equipment.

 13.- Method according to claim 12, wherein the data used in the analysis and processing step further comprises additional environmental data comprising
25 meteorological data and/or geographic data and/or data of a radio environment.