

DESCRIPTION

TITLE: Transport installation on which a vehicle travels and method for controlling such a vehicle

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Technical field of the invention

The present invention concerns a transport installation comprising a track on which a vehicle travels.

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The invention also concerns a method for controlling said vehicle.

State of the art

In a context where new modes of urban displacement are developing, attention is paid to public transport using installations comprising airways. For this, it is envisaged to use compact vehicles equipped with rollers to travel on the airway generally composed of cables.

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It is known from the state of the art, cable installations of the aerial tramway type, comprising at least one carrying cable. These installations are satisfactory in that they make it possible to transport people in an urban environment, in particular in areas where the surface available on the ground is saturated. In the vast majority of cases, the vehicle is naturally positioned directly above the point of attachment to the track. Although the hangers of the vehicle are sometimes damped, it is however not possible to avoid the phenomena of tilting, oscillations which even damped may degrade the comfort of the passengers. In addition, the use of a hanger does not make it possible to compensate for transverse oscillations in the manner of a pendular train. The course of the center of gravity of the passenger compartment is for its part necessarily generally parallel to the curve of the deformation of the cable and cannot be maintained in a zone of optimum comfort.

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Systems without hangers also exist, the latter are caused to follow the deformation of the cable or set themselves on a straight path with correction of the vertical position of the cabin.

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Thus none of these systems makes it possible to set a traveler compartment on a trajectory relatively independent of that of the travelling tracks while simultaneously allowing the maintenance of the acceleration felt at the floor of the vehicle compartment at a given value close to the gravitational acceleration and in a direction as perpendicular as possible to the floor.

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Maintaining the acceleration felt by a passenger or a load perpendicular to the floor and within acceptable values is necessary to preserve the integrity and possibly

the comfort of the transported load, in particular when the compartment is subjected to unforeseeable events because they depend on exogenous (wind, temperatures, etc.) and endogenous (influence of passengers, other vehicles, etc.) phenomena.

5 **Object of the invention**

The object of the present invention is to propose a solution which responds to all or part of the aforementioned problems.

This object may be achieved through the implementation of a method for controlling a vehicle moving on a track, the vehicle comprising rollers intended for contact on at least one support defining the track, a floor intended for transporting a load, said floor cooperating with the rollers through a set of suspensions, the set of suspensions comprising at least one suspension, the at least one suspension being controlled by at least one force setpoint defining the force exerted by the at least one suspension on the floor, the method being implemented by a control command system and comprising the following steps:

- collection of a pitch parameter of the floor, representative of the pitch rotational acceleration of the floor;
- determination of a longitudinal correction command intended to modify the at least one force setpoint;
- application of the longitudinal correction command to the set of suspensions, the longitudinal correction command being representative of a force setpoint longitudinal differential, said longitudinal differential being applied between two suspensions associated respectively with two rollers disposed longitudinally in the displacement direction of the vehicle, the differential being dependent on the distance between the two rollers and on the pitch parameter of the floor.

The arrangements previously described make it possible to control the inclination of the vehicle to maintain the load present in a so-called comfortable situation vis-à-vis the acceleration or deceleration of the vehicle. For example, the comfortable situation may correspond to a situation where the acceleration felt by the load is substantially perpendicular to the floor.

By substantially perpendicular, is meant a direction included in an angular interval less than 5° with respect to the direction of the gravitational acceleration and more particularly in an angular interval less than 2.86° with respect to the direction of the gravitational acceleration.

Synergistically, the arrangements described above make it possible to place the load in the vehicle in a comfortable situation, in particular when the vehicle is subjected to a pitch rotation by the action of a frontal wind.

Advantageously, the use of a pitch parameter of the floor, representative of the pitch rotational acceleration of the floor makes it possible to adapt to variations in the pitch speed of the floor and makes it possible to make a dynamic correction of the inclination of the floor.

5 The control method may also have one or more of the following characteristics, taken alone or in combination.

According to one embodiment, the step of collecting a pitch parameter of the floor comprises collecting the value and the sign of the value of the pitch parameter of the floor, the control method comprising a step of comparing the value of the pitch
10 parameter of the floor with a predetermined comfort pitch value, the step of determining a longitudinal correction command being implemented in the case where the value of the pitch parameter of the floor is greater than the comfort pitch value.

The arrangements previously described make it possible in particular to reduce the pitch rotational acceleration to a value less than the comfort pitch acceleration.

15 According to one embodiment, the longitudinal differential applied between two suspensions associated respectively with two rollers disposed longitudinally in the displacement direction of the vehicle is determined so as to maintain the acceleration of the load substantially perpendicular to the floor.

Thus, and advantageously, the longitudinal differential is configured to adapt to
20 variations in the speed of the vehicle, in particular when it accelerates or decelerates on the track. It is therefore well understood that the longitudinal differential may lead to an inclination of the floor of the vehicle different from a horizontal inclination.

According to one embodiment, the force setpoint is applied by a command of the torque of a motor controlling a suspension.

25 According to one embodiment, the longitudinal correction command depends on the mass of the vehicle.

According to one embodiment, the control method comprises the following steps:

30 - collection of an acceleration parameter on the track, representative of the acceleration of the floor longitudinally in the displacement direction of the vehicle;

- modification of the longitudinal differential taking into account the acceleration parameter on the track.

35 According to one embodiment, the step of collecting an acceleration parameter on the track comprises collecting the value and the sign of the value of the acceleration parameter on the track, the control method comprising a step of comparing the value of the acceleration parameter on the track with a predetermined comfort floor acceleration value, the step of modifying the longitudinal differential being implemented

in the case where the acceleration parameter value on the track is greater than the comfort floor acceleration value.

The arrangements previously described make it possible to anticipate the movement of the floor of the vehicle in case of acceleration or braking.

5 Thus, according to one embodiment, the floor of the vehicle is inclined forwards in the case where the vehicle accelerates on the track.

Alternatively or in conjunction, the floor of the vehicle may be inclined rearward when the vehicle slows or brakes on the track.

10 According to one embodiment, the control method comprises the following steps:

- collection of a crushing parameter of the load, representative of the acceleration of the floor along an axis substantially perpendicular to the floor;

- determination of a normal correction command intended to modify the at least one force setpoint;

15 - application of the normal correction command to the set of suspensions, the vertical correction command being intended to drive the suspensions so as to bring back the crushing parameter of the load in one direction and with an intensity substantially close to the gravitational acceleration.

20 By substantially close intensity, is meant an intensity included in an interval of 2.5 m/s^2 centered around the intensity of the gravitational acceleration or more particularly in an interval of 1.6 m/s^2 centered around the intensity of the gravitational acceleration.

25 By substantially close direction is meant a direction included in an angular interval less than 5° with respect to the direction of the gravitational acceleration and more particularly in an angular interval less than 2.86° with respect to the direction of the gravitational acceleration.

30 According to one embodiment, the step of collecting a crushing parameter of the load comprises collecting the value and the sign of the value of the crushing parameter of the load, the control method comprising a step of comparing the value of the crushing parameter of the load, with a predetermined comfort normal acceleration value, the step of determining a normal correction command being implemented in the case where the crushing parameter value of the load is greater than the comfort normal acceleration value.

35 According to one embodiment, the control method comprises the following steps:

- collection of a roll parameter of the floor, representative of the roll rotational acceleration of the floor;

- determination of a lateral correction command intended to modify the at least one force setpoint;

- application of the lateral correction command to the set of suspensions, the lateral correction command being representative of a force setpoint lateral differential, said lateral differential being applied between two suspensions associated respectively with two rollers disposed laterally with respect to the displacement direction of the vehicle and being dependent on the distance between the two rollers and on the roll parameter of the floor.

According to one embodiment, the step of collecting a roll parameter of the floor comprises collecting the value and the sign of the value of the roll parameter of the floor, the control method comprising a step of comparing the value of the roll parameter of the floor, with a predetermined comfort roll value, the step of determining a lateral correction command being implemented in the case where the value of the roll parameter of the floor is greater than the comfort roll value.

According to one embodiment, the control method comprises the following steps:

- collection of a yaw parameter of the floor, representative of the yaw rotational acceleration of the floor, comprising the collection of the value and the sign of the value of the yaw parameter of the floor;

- comparison of the value of the yaw parameter of the floor, with a predetermined comfort yaw value;

- in the case where the value of the yaw parameter of the floor is greater than the comfort yaw value, determination of a yaw correction command intended to modify the at least one force setpoint

- application of the yaw correction command to the set of suspensions, the yaw correction command being representative of a yaw force setpoint differential, said yaw force setpoint differential being applied to one or several of the suspensions of the set of suspensions.

According to one embodiment, the steps of collecting the pitch parameter of the floor, the acceleration parameter on the track, the crushing parameter of the load, the roll parameter of the floor or the yaw parameter of the floor are carried out by an inclinometer or through a kinematic measurement device making it possible to know the 6 kinematic characteristics, such as for example an inertial unit. Said inclinometer or said kinematic measurement device being able to be included in the control command system.

According to one embodiment, the force setpoint applied to each suspension is configured so as not to be less than an adhesion limit force. In this way, the control

method makes it possible to avoid the sliding of the rollers on the support, in particular if a roller is unloaded.

According to one embodiment, the control method comprises a step of measuring the mass of the load and its distribution in the vehicle, the longitudinal differential and/or the lateral differential being dependent on the mass of the load and on the distribution of the mass in the vehicle.

According to one embodiment, the step of measuring the mass of the load is carried out by measuring the force on the rollers, in particular when stationary.

According to one embodiment, the step of measuring the mass of the load is carried out by strain gauges.

According to one embodiment, the control method comprises the following steps:

- measurement of the position of each of the rollers with respect to the vehicle;

- in the case where the position of a roller is outside a predetermined target interval, determination of a return command intended to modify the at least one force setpoint;

- application of the return command to the set of suspensions so as to bring the position of each of the rollers back to the target interval.

According to one embodiment, the step of determining a return command comprises a step of transmitting a speed reduction instruction to an external system for controlling the displacement speed of the vehicle, in the purpose of reducing the displacement speed of the vehicle.

The provisions previously described guarantee the slowing down of the vehicle in the case where it is not possible to maintain the stroke of the suspensions within a target interval, for example a safety interval. Thus and advantageously, the control method makes it possible to limit the speed of the vehicle, in particular when it is subjected to unforeseeable exogenous (wind, temperatures) or endogenous (passengers, other vehicles) phenomena.

According to one embodiment, the control method may comprise a step of blocking at least one suspension in predetermined positions. For example when the vehicle is stationary or when it has broken down.

According to one embodiment, the track comprises a plurality of track sections defined by a section type and in which the control command system comprises a position sensor, the control method comprising the following steps

- measurement of the position of the vehicle on the track;

- determination of a track section and a section type corresponding to the position of the vehicle on the track;

- modification of the comfort pitch value, the comfort floor acceleration value, the comfort normal acceleration value and the target interval in accordance with the section type.

According to one embodiment, the support comprises at least two cables stretched between at least two pylons, the vehicle being suspended by the cables above the ground through the rollers.

In general, the cables may be located at approximately the same altitude and present a substantially similar deformation profile on either side.

According to one embodiment, the comfort pitch value, the comfort floor acceleration value, the comfort normal acceleration value and the target interval evolve in accordance with the state of the track.

According to one embodiment, the comfort pitch value, the comfort floor acceleration value, the comfort normal acceleration value and the target interval are communicated by an operator or an external control unit.

According to one embodiment, the control method comprises a step of collecting shape data of the track representative of the shape of the travelling track extending upstream and a step of modifying the comfort pitch value and/or the comfort floor acceleration value and/or the comfort normal acceleration value and/or the target interval in accordance with the shape data of the track.

In particular, the step of collecting shape data of the track may be used to drive the set of suspensions according to a predetermined program, in accordance in particular with the collection of the pitch parameter of the floor, the collection of the acceleration parameter on the track, the collection of the crushing parameter of the load, the collection of the roll parameter of the floor, the collection of the yaw parameter of the floor or the position of the vehicle on the track and its mass.

The object of the invention may also be achieved thanks to the implementation of an installation for transporting a load comprising a support comprising at least two stretched cables extending between at least two pylons so as to form a track on which a vehicle travels; the vehicle comprising rollers intended for contact on the support, a floor intended for transporting the load, said floor cooperating with the rollers through a set of suspensions, the set of suspensions having a travel and being controlled by at least one force setpoint defining the force exerted by each of the rollers on the floor and a control command system configured to drive the set of suspensions by a control method of the type described previously.

The transport installation may also have one or more of the following characteristics, taken alone or in combination.

According to one embodiment, the support, on which the wheels or the rollers are in contact, is a rail or a cable.

According to one embodiment, the vehicle comprises wheels in contact with the support.

According to one embodiment, each suspension of the set of suspensions may be equipped with a brake configured to allow its movement or alternatively slow down and/or block its movement.

According to one embodiment, the transported load comprises people.

According to one embodiment, the control command system comprises a kinematic measurement device configured to measure kinematic data of the floor of the vehicle, for example an inertial unit.

According to one embodiment, each suspension of the set of suspensions has a travel of between 1.5 m and 3.0 m.

According to one embodiment, the vehicle is self-propelled.

Brief description of the drawings

Other aspects, objects, advantages and characteristics of the invention will appear better on reading the following detailed description of preferred embodiments thereof, given by way of non-limiting example, and made with reference to the appended drawings on which ones:

[Fig. 1] is a sectional view of the vehicle according to one embodiment of the invention.

[Fig. 2] is a schematic view of the displacements in the space that may be undergone by the vehicle of Figure 1.

[Fig. 3] is a diagram illustrating an implementation mode of the control method according to one embodiment of the invention.

[Fig. 4] is a schematic view of the transport installation according to a first embodiment of the invention.

[Fig. 5] is a schematic view of the transport installation according to a second embodiment of the invention.

[Fig. 6] is a schematic view of the transport installation according to a third embodiment of the invention.

[Fig. 7] is a schematic view of the transport installation according to a fourth embodiment of the invention.

Detailed description

In the figures and in the remainder of the description, the same references represent identical or similar elements. In addition, the different elements are not represented to scale so as to favor the clarity of the figures. Furthermore, the different

embodiments and variants are not mutually exclusive and may be combined with one another.

The invention concerns an installation 1 for transporting a load comprising a track on which a vehicle 20 travels.

5 As illustrated in Figure 1, the vehicle 20 comprises rollers 24 intended for contact on a support 10 comprising at least one cable 12 of the transport installation 1 defining the track and a floor 22 intended for transporting the load. The floor 22 cooperates in particular with the rollers 24 through a set of suspensions 26 which has a travel. The set of suspensions 26 is controlled by at least one force setpoint defining the force
10 exerted by each of the rollers 24 on the floor 22.

The invention also concerns a control method implemented by a control command system 28 included in said vehicle 20, so as to drive the set of suspensions 26.

The embodiments described below will be better understood with reference to
15 Figure 2 which schematically describes the displacements in the space that may be undergone by the vehicle 20. It is therefore clearly understood that the spatial references described below illustrate a non-limiting embodiment of the invention. According to this embodiment, the floor 22 makes it possible to define an orthonormal reference frame, centered at the center of gravity of the floor 22 and comprising three
20 axes:

- An axis denoted "X" extending longitudinally along the floor 22 and oriented in the preferred direction of progression of the vehicle 20 about which the vehicle is caused to carry out a roll movement denoted "Rx" and defined by a roll speed and an acceleration of this speed.

- An axis denoted "Y" extending laterally in the plane of the floor 22 and perpendicular to the axis X, about which the vehicle 20 is caused to carry out a pitch movement denoted "Ry", defined by a pitch speed and a pitch acceleration.

- An axis denoted "Z" extending transversely with respect to the floor 22, about which the vehicle 20 is caused to carry out a yaw movement denoted
30 "Rz", defined by a yaw speed and a yaw acceleration.

Figure 3 illustrates an embodiment of the control method implemented by the control command system 28.

According to this embodiment, the control command system 28 collects Col1 a comfort pitch value, a comfort floor acceleration value, a comfort normal acceleration
35 value and a target interval communicated by an operator or an external control system 27.

According to a non-limiting variant, a moment of inertia of the empty vehicle 20, the mass of the empty vehicle 20 and the length of the floor 22 may be collected. A

step of measuring Mes1 the mass of the load and its distribution in the vehicle 20 may then be carried out. For example, the step of measuring Mes1 the mass of the load may be carried out by measuring the force on the rollers 24, in particular when the vehicle 20 is stationary.

5 According to one embodiment, the step of measuring Mes1 the mass of the load is carried out by strain gauges.

The control method may further comprise a step of measuring Mes2 the position of each of the rollers 24 with respect to the vehicle 20. Thus, in the case where the position of a roller 24 is outside the predetermined target interval, the control method
10 may determine Det5 a return command intended to modify the at least one force setpoint. In this case, a step of applying Apl5 the return command to the set of suspensions 26 is carried out, so as to bring the position of each of the rollers 24 back into the target interval.

In certain non-limiting configurations, the step of determining Det5 a return
15 command comprises a step of transmitting Trs1 a speed reduction instruction to the external system 27 for controlling the displacement speed of the vehicle 20, with the aim of reducing the displacement speed of the vehicle 20.

The arrangements previously described guarantee the slowing down of the vehicle 20 in the case where it is not possible to maintain the stroke of the suspensions
20 26 within the target interval, for example when the target interval corresponds to a safety interval. Thus and advantageously, the control method makes it possible to limit the speed of the vehicle 20, in particular when it is subjected to unpredictable exogenous (wind, temperatures) or endogenous (passengers, other vehicles) phenomena.

25 According to one embodiment, the control method may comprise a step of blocking at least one suspension in predetermined positions. For example when the vehicle 20 is stationary or when it has broken down.

Figures 4 to 7 illustrate the transport installation 1 when the vehicle 20 is driven by the control method. In particular, the figures illustrate one of the two cables 12 and
30 one of the two pylons 14 between which the cables 12 are stretched. The vehicle 20 is suspended by the cables 12 above the ground through the rollers 24.

In general, the cables 12 may be located at approximately the same altitude and have a substantially similar deformation profile on either side.

The control method may comprise a step of collecting Col3 a pitch parameter of
35 the floor, representative of the pitch rotational acceleration of the floor about the axis Ry. The step of collecting Col3 a pitch parameter of the floor may in particular comprise collecting the value and the sign of the value of the pitch parameter of the floor. The value of the pitch parameter of the floor may be compared Cmp1 to the comfort pitch

value. In the case where the value of the pitch parameter of the floor is greater than the comfort pitch acceleration value, a longitudinal correction command intended to modify the at least one force setpoint is determined Det1. The longitudinal correction command is representative of a force setpoint longitudinal differential applied between
 5 two suspensions 26 associated respectively with two rollers 24 disposed longitudinally in the displacement direction of the vehicle 20. The differential is generally dependent on the distance between the two rollers 24, on the mass of the vehicle and on the pitch parameter of the floor.

The control method may also comprise a step of collecting Col4 an acceleration
 10 parameter on the track, representative of the value and of the sign of the value of the acceleration of the floor longitudinally in the displacement direction of the vehicle 20. A step of comparing Cmp2 the value of the acceleration parameter on the track with a comfort floor acceleration value may be carried out. In the case where the acceleration parameter value on the track is greater than the comfort floor acceleration value, the
 15 longitudinal differential may be modified Mod1 taking into account the acceleration parameter on the track. The longitudinal correction command may then be applied Apl1 to the set of suspensions 26, for example by a command of the torque of a motor controlling the suspension 26.

In this way, it is possible to reduce the pitch rotational acceleration to a value
 20 less than the comfort pitch acceleration.

The arrangements previously described make it possible to control the inclination of the vehicle 20 to maintain the load present in a so-called comfortable situation vis-à-vis the acceleration of the vehicle 20. For example, the comfortable situation may correspond to a situation where the acceleration felt by the load is
 25 substantially perpendicular to the floor 22.

By substantially perpendicular, is meant a direction included in an angular interval less than 5° with respect to the direction of the gravitational acceleration and more particularly in an angular interval less than 2.86° with respect to the direction of the gravitational acceleration.

30 Synergistically, the previously described arrangements make it possible to place the load in the vehicle 20 in the comfortable situation, in particular when the vehicle 20 is subjected to a pitch rotation by the action of a frontal wind.

Alternatively or jointly, it is possible to anticipate the movement of the floor 22 of the vehicle 20 in case of acceleration or braking. Thus, as illustrated in Figure 5, the
 35 floor 22 of the vehicle 20 may be inclined forward in the case where the vehicle 20 accelerates on the track. Furthermore, as illustrated in Figure 6, the floor 22 of the vehicle 20 may be inclined rearward when the vehicle 20 slows down or brakes on the track.

The control method may also comprise the following steps:

- collection Col5 of a crushing parameter of the load, representative of the acceleration of the floor along the axis Z. The crushing parameter of the load may in particular comprise the value and the sign of the value of the acceleration of the floor along the axis Z;

- collection Col6 of a roll parameter of the floor, representative of the roll rotational acceleration Rx of the floor. The roll parameter of the floor may in particular comprise the value and the sign of the value of the roll rotational acceleration Rx of the floor

- collection Col7 of a yaw parameter of the floor, representative of the yaw rotational acceleration Rz of the floor, comprising the collection of the value and the sign of the value of the yaw parameter of the floor;

According to one embodiment, the steps of collecting Col3, Col4, Col5, Col6, Col7 the pitch parameter of the floor, the acceleration parameter on the track, the crushing parameter of the load, the roll parameter of the floor or the yaw parameter of the floor are carried out by an inclinometer or through a kinematic measurement device 29 making it possible to know the 6 kinematic characteristics, such as for example an inertial unit. Said inclinometer or said kinematic measurement device 29 being able to be included in the control command system 28.

Following each of these steps, the control method may comprise steps of comparing the collected values, for example a step of comparing Cmp3 the value of the crushing parameter of the load with the comfort normal acceleration value. In the case where the crushing parameter value of the load is greater than the comfort normal acceleration value, a normal correction command intended to modify the at least one force setpoint is determined Det 2.

In addition, a step of comparing Cmp4 the value of the roll parameter of the floor with the comfort roll value may be carried out. In the case where the value of the roll parameter of the floor is greater than the comfort roll value, a lateral correction command intended to modify the at least one force setpoint is determined Det3.

Finally, a step of comparing Cmp5 the value of the yaw parameter of the floor with a predetermined comfort yaw value may be implemented. In the case where the value of the yaw parameter of the floor is greater than the comfort yaw value, a yaw correction command intended to modify the at least one force setpoint is determined Det 4.

According to one embodiment, the longitudinal differential and/or the lateral differential are dependent on the mass of the load and on the distribution of the mass in the vehicle 20.

The control method may then implement:

- a step of applying Apl2 the normal correction command to the set of suspensions 26, the vertical correction command being intended to drive the suspensions 26 so as to bring back the crushing parameter of the load in one direction and with an intensity substantially close to the gravitational acceleration. By substantially close intensity, is meant an intensity included in an interval of 2.5 m/s^2 centered around the intensity of the gravitational acceleration, or more particularly, in an interval of 1.6 m/s^2 centered around the intensity of the gravitational acceleration and by substantially close direction is meant a direction included in an angular interval less than 5° with respect to the direction of the gravitational acceleration and more particularly in an angular interval less than 2.86° with respect to the direction of the gravitational acceleration;

- a step of applying Apl3 the lateral correction command to the set of suspensions 26, the lateral correction command being representative of a force setpoint lateral differential, said lateral differential being applied between two suspensions 26 associated respectively with two rollers 24 disposed laterally with respect to the displacement direction of the vehicle 20 and being dependent on the distance between the two rollers 24 and on the roll parameter of the floor;

- a step of applying Apl4 the yaw correction command to the set of suspensions 26, the yaw correction command being representative of a yaw force setpoint differential, said yaw force setpoint differential being applied to one or more of the suspensions 26 of the set of suspensions 26.

In general, the force setpoint applied to each suspension 26 is configured so as not to be less than a limit adhesion force. In this way, the control method makes it possible to avoid the sliding of the rollers 24 on the support 10, in particular if a roller 24 is unloaded.

The previously described embodiment may be implemented by the following algorithm:

1. Comparison of the position of each suspension of each roller 24 (Z_{gar} , Z_{gav}) on the set of suspensions 26 with the collected target interval $[Z_{min}; Z_{max}]$.

a. If the following conditions are present

$$Z_{gar} \in [Z_{min}; Z_{max}]$$

$$Z_{gav} \in [Z_{min}; Z_{max}],$$

Execution of steps 2 to 4 of the algorithm.

b. If the conditions are not present, transmission Trs1 of a speed reduction instruction and application Apl5 of the return command.

2. Comparison of the value of the pitch parameter of the floor (α) with the comfort pitch value $[\alpha_{min}; \alpha_{max}]$.

a. If the following condition is validated:

$\alpha \in [\alpha_{min}; \alpha_{max}]$ then a longitudinal setpoint coefficient K_1 is set to 0.

b. If the condition is not met, then the longitudinal setpoint coefficient K_1 is defined as:

$$K_1 = constant\ 1 * \left(\alpha - \frac{\alpha_{min} + \alpha_{max}}{2} \right)$$

Where constant 1 depends on the length of the floor 22 between the suspensions, on the moment of inertia of the empty vehicle 20, on the mass of the empty vehicle 20, on the mass of the load.

3. Comparison of the projection A_{xz} of the acceleration of floor 22 on the plane defined by the axes X and Z with the comfort normal acceleration value $[A_{xzmin}; A_{xzmax}]$.

a. If the following condition is validated:

$$A_{xz} \in [A_{xzmin}; A_{xzmax}]$$

determination Det 2 of a normal correction coefficient K_2 at 0.

b. If the condition is not met, determination Det 2 of the normal correction coefficient at:

$$K_2 = constant\ 2 * \left(A_{xz} - \frac{A_{xymin} + A_{xymax}}{2} \right)$$

where constant 2 depends on the length of the floor 22 between the suspensions, on the moment of inertia of the empty vehicle 20, on the mass of the empty vehicle 20, on the mass of the load.

4. Application Apl1 of the longitudinal differential and Apl2 of the normal correction command as a function of K_1 and K_2 :

$$F_{arCons} - F_{avCons} = K_1$$

$$F_{arCons} + F_{avCons} = K_2$$

where F_{avCons} is the force setpoint exerted by the front suspension between the floor 22 and the roller 24; and

where F_{arCons} is the force setpoint exerted by the rear suspension between the floor 22 and the roller 24.

F_{avCons} and F_{arCons} make it possible in particular to drive the forces in each suspension of the set of suspensions 26 in accordance with a closed loop regulation law of the PID type

In general, constant 1 and constant 2 may be dimensioned by experimental measurements, or studies specific to the vehicle 20 and the used support 10.

According to one embodiment, the first algorithm may take into account an interval of speed ($\dot{Z}_{gar}$ and $\dot{Z}_{gav}$) and acceleration ($\ddot{Z}_{gar}$ and $\ddot{Z}_{gav}$) of the position of each roller 24 with respect to the set of suspensions 26.

According to one embodiment, the determination Det5 of a return command is corrected proportionally in accordance with the position of each roller 24 (Z_{gar} , Z_{gav}) with respect to the bounds of the target interval [Z_{min} ; Z_{max}]. In this way, the return command may be increased when the position of each roller 24 approaches the bounds of the target interval.

According to one embodiment, the setpoint longitudinal differential may be determined in accordance with the rotation speed about the axis Y and the rotation acceleration about the axis Y.

According to one embodiment, the normal correction command is determined in accordance with the speed and the acceleration of the vehicle 20 on the track.

Referring to Figure 7, the track may comprise a plurality of track sections S1, S2, S3 defined by a section type. The control command system 28 may then comprise a position sensor capable of measuring Mes3 the position of the vehicle 20 on the track. This makes it possible to determine Det6 a track section and a section type corresponding to the position of the vehicle 20 on the track. The control method may thus comprise a step of modifying Mod2 the comfort pitch value, the comfort floor acceleration value, the comfort normal acceleration value and the target interval in accordance with the section type.

Advantageously, the comfort pitch value, the comfort floor acceleration value, the comfort normal acceleration value and the target interval may evolve in accordance with the state of the track. In particular, according to an embodiment in which the control method comprises a step of collecting Col8 shape data of the track representative of the shape of the travelling track extending upstream, it is possible to carry out a step of modifying Mod3 the comfort pitch value and/or the comfort floor acceleration value and/or the comfort normal acceleration value and/or the target interval in accordance with the shape data of the track.

According to a non-limiting variant, the step of collecting Col8 the shape data of the track may be used to drive the set of suspensions 26 in accordance with a predetermined program, depending in particular on the collection Col3 of the pitch parameter of the floor, the collection Col4 of the acceleration parameter on the track, the collection Col5 of the crushing parameter of the load, the collection Col6 of the roll parameter of the floor, the collection Col7 of the yaw parameter of the floor or on the position of the vehicle 20 on the track and on its mass.

As indicated above, the invention also concerns an installation 1 for transporting a load illustrated in part in Figures 4 to 7. In general, the transported load comprises people.

The transport installation 1 comprises a support 10 comprising at least two stretched cables 12 extending between at least two pylons 14 so as to form a track on which a vehicle 20 travels. Advantageously, the vehicle 20 may be self-propelled.

5 The vehicle 20 comprises rollers 24 intended for contact on the support 10 and a floor 22 intended for transporting the load.

According to one embodiment, the vehicle 20 comprises wheels in contact with the support 10.

According to one embodiment, the support 10, on which the wheels or the rollers 24 are in contact, is a rail or a cable 12.

10 The floor 22 cooperates in particular with the rollers 24 through a set of suspensions 26. Each suspension 26 of the set of suspensions 26 may in particular have a travel of between 1.5 m and 3.0 m. The set of suspensions 26 is controlled by at least one force setpoint defining the force exerted by each of the rollers 24 on the floor 22.

15 According to one embodiment, each suspension 26 of the set of suspensions 26 may be equipped with a brake configured to allow its movement or alternatively slow down and/or block its movement.

Finally, the vehicle 20 comprises a control command system 28 configured to drive the set of suspensions 26 by a control method of the type described previously.

20 The control command system 28 may in particular comprise a kinematic measurement device 29 configured to measure kinematic data of the floor 22 of the vehicle 20, for example an inertial unit.

CLAIMS

1. A control method for controlling a vehicle (20) moving on a track, the vehicle (20) comprising rollers (24) intended for contact on at least one support (10) defining the track, a floor (22) intended for transporting a load, said floor (22) cooperating with the rollers (24) through a set of suspensions (26), the set of suspensions (26) comprising at least one suspension (26), the at least one suspension (26) being controlled by at least one force setpoint defining the force exerted by the at least one suspension (26) on the floor (22), the method being implemented by a control command system (28) and comprising the following steps:

 - a. collection (Col3) of a pitch parameter of the floor, representative of the pitch rotational acceleration of the floor;
 - b. determination (Det1) of a longitudinal correction command intended to modify the at least one force setpoint;
 - c. application (Apl1) of the longitudinal correction command to the set of suspensions (26), the longitudinal correction command being representative of a longitudinal force setpoint differential, said longitudinal differential being applied between two suspensions (26) associated respectively with two rollers (24) disposed longitudinally in the displacement direction of the vehicle (20), the differential being dependent on the distance between the two rollers (24) and on the pitch parameter of the floor.
2. The control method according to claim 1, wherein the step of collecting (Col3) a pitch parameter of the floor comprises collecting the value and the sign of the value of the pitch parameter of the floor, the control method comprising a step of comparing (Cmp1) the value of the pitch parameter of the floor with a predetermined comfort pitch value, the step of determining (Det1) a longitudinal correction command being implemented in the case where the value of the pitch parameter of the floor is greater than the comfort pitch value.
3. The control method according to any one of claims 1 or 2 comprising the following steps:

 - a. collection (Col4) of an acceleration parameter on the track, representative of the acceleration of the floor longitudinally in the displacement direction of the vehicle (20);
 - b. modification (Mod1) of the longitudinal differential taking into account the acceleration parameter on the track.
4. The control method according to claim 3, wherein the step of collecting (Col4) an acceleration parameter on the track comprises collecting the value and the sign of the value of the acceleration parameter on the track, the control method comprising a

step of comparing (Cmp2) the value of the acceleration parameter on the track with a predetermined comfort floor acceleration value, the step of modifying (Mod1) the longitudinal differential being implemented in the case where the acceleration parameter value on the track is greater than the comfort floor acceleration value.

5 5. The control method according to any one of claims 1 to 4 comprising the following steps:

 a. collection (Col5) of a crushing parameter of the load, representative of the acceleration of the floor along an axis substantially perpendicular to the floor (22);

10 b. determination (Det2) of a normal correction command intended to modify the at least one force setpoint;

 c. Application (Apl2) of the normal correction command to the set of suspensions (26), the vertical correction command being intended to drive the suspensions (26) so as to bring back the crushing parameter of the load in one
15 direction and with an intensity substantially close to the gravitational acceleration.

 6. The control method according to claim 5, wherein the step of collecting (Col5) a crushing parameter of the load comprises collecting the value and the sign of the value of the crushing parameter of load, the control method comprising a step of
20 comparing (Cmp3) the value of the crushing parameter of the load with a predetermined comfort normal acceleration value, the step of determining (Det2) a normal correction command being implemented in the case where the crushing parameter value of the load is greater than the comfort normal acceleration value.

 7. The control method according to any one of claims 1 to 6 comprising the
25 following steps:

 a. collection (Col6) of a roll parameter of the floor, representative of the roll rotational acceleration of the floor;

 b. determination (Det3) of a lateral correction command intended to modify the at least one force setpoint;

30 c. application (Apl3) of the lateral correction command to the set of suspensions (26), the lateral correction command being representative of a force setpoint lateral differential, said lateral differential being applied between two suspensions (26) associated respectively with two rollers (24) disposed laterally with respect to the displacement direction of the vehicle (20) and being
35 dependent on the distance between the two rollers (24) and on the roll parameter of the floor.

 8. The control method according to claim 7, wherein the step of collecting (Col6) a roll parameter of the floor comprises collecting the value and the sign of the value of

the roll parameter of the floor, the control method comprising a step of comparing (Cmp4) the value of the roll parameter of the floor with a predetermined comfort roll value, the step of determining (Det3) a lateral correction command being implemented in the case where the value of the roll parameter of the floor is greater than the comfort roll value.

9. The control method according to any one of claims 1 to 8, comprising a step of measuring (Mes1) the mass of the load and its distribution in the vehicle (20), the longitudinal differential and/or the lateral differential being dependent on the mass of the load and on the distribution of the mass in the vehicle (20).

10. The control method according to any one of claims 1 to 9 comprising the following steps:

a. measurement (Mes2) of the position of each of the rollers (24) with respect to the vehicle (20);

b. in the case where the position of a roller (24) is outside a predetermined target interval, determination (Det5) of a return command intended to modify the at least one force setpoint;

c. application (Apl5) of the return command to the set of suspensions (26) so as to bring the position of each of the rollers (24) back to the target interval.

11. The control method according to claim 10, wherein the step of determining (Det5) a return command comprises a step of transmitting (Trs1) a speed reduction instruction to an external system (27) for controlling the displacement speed of the vehicle (20), with the aim of reducing the displacement speed of the vehicle (20).

12. The control method according to claims 2, 4, 6 and 10 and according to any one of claims 1 to 11, wherein the track comprises a plurality of track sections (S1, S2, S3) defined by a section type and wherein the control command system (28) comprises a position sensor, the control method comprising the following steps

a. measurement (Mes3) of the position of the vehicle (20) on the track;

b. determination (Det6) of a track section and of a section type corresponding to the position of the vehicle (20) on the track;

c. modification (Mod2) of the comfort pitch value, the comfort floor acceleration value, the comfort normal acceleration value and the target interval in accordance with the section type.

13. The control method according to claim 12, wherein the comfort pitch value, the comfort floor acceleration value, the comfort normal acceleration value and the target interval evolve in accordance with the state of the track.

14. The control method according to any one of claims 12 or 13, comprising a step of collecting (Col8) shape data of the track, representative of the shape of the travelling track extending upstream and a step of modifying (Mod3) the comfort pitch

value and/or the comfort floor acceleration value and/or the comfort normal acceleration value and/or the target interval in accordance with the shape data of the track.

5 15. An installation (1) for transporting a load comprising a support (10) comprising at least two stretched cables (12) extending between at least two pylons (14) so as to form a track on which a vehicle (20) travels; the vehicle (20) comprising rollers (24) intended for contact on the support (10), a floor (22) intended for transporting the load, said floor (22) cooperating with the rollers (24) through a set of suspensions (26), the set of suspensions (26) having a travel and being controlled by
10 at least one force setpoint defining the force exerted by each of the rollers (24) on the floor (22) and a control command system (28) configured to drive the set of suspensions (26) by a control method according to any of claims 1 to 14.

16. The transport installation (1) according to claim 15, wherein the transported load comprises people.

15 17. The transport installation (1) according to any one of claims 15 or 16, wherein the control command system (28) comprises a kinematic measurement device (29) configured to measure kinematic data of the floor (22) of the vehicle (20), for example an inertial unit.

20 18. The transport installation (1) according to any one of claims 15 to 17, wherein each suspension (26) of the set of suspensions (26) has a travel of between 1.5 m and 3.0 m.

19. The transport installation (1) according to any one of claims 15 to 18, wherein the vehicle (20) is self-propelled.